ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

NOVEMBER 1960

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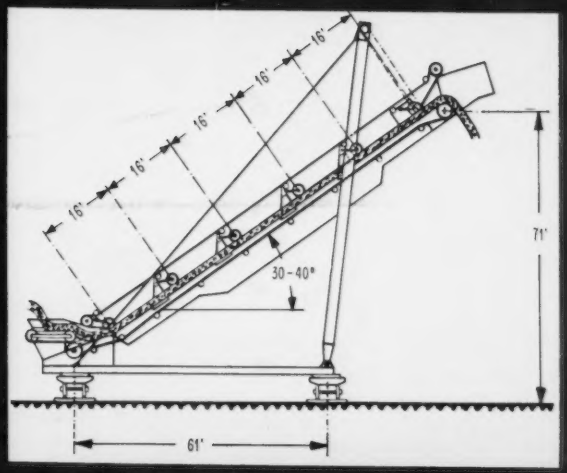

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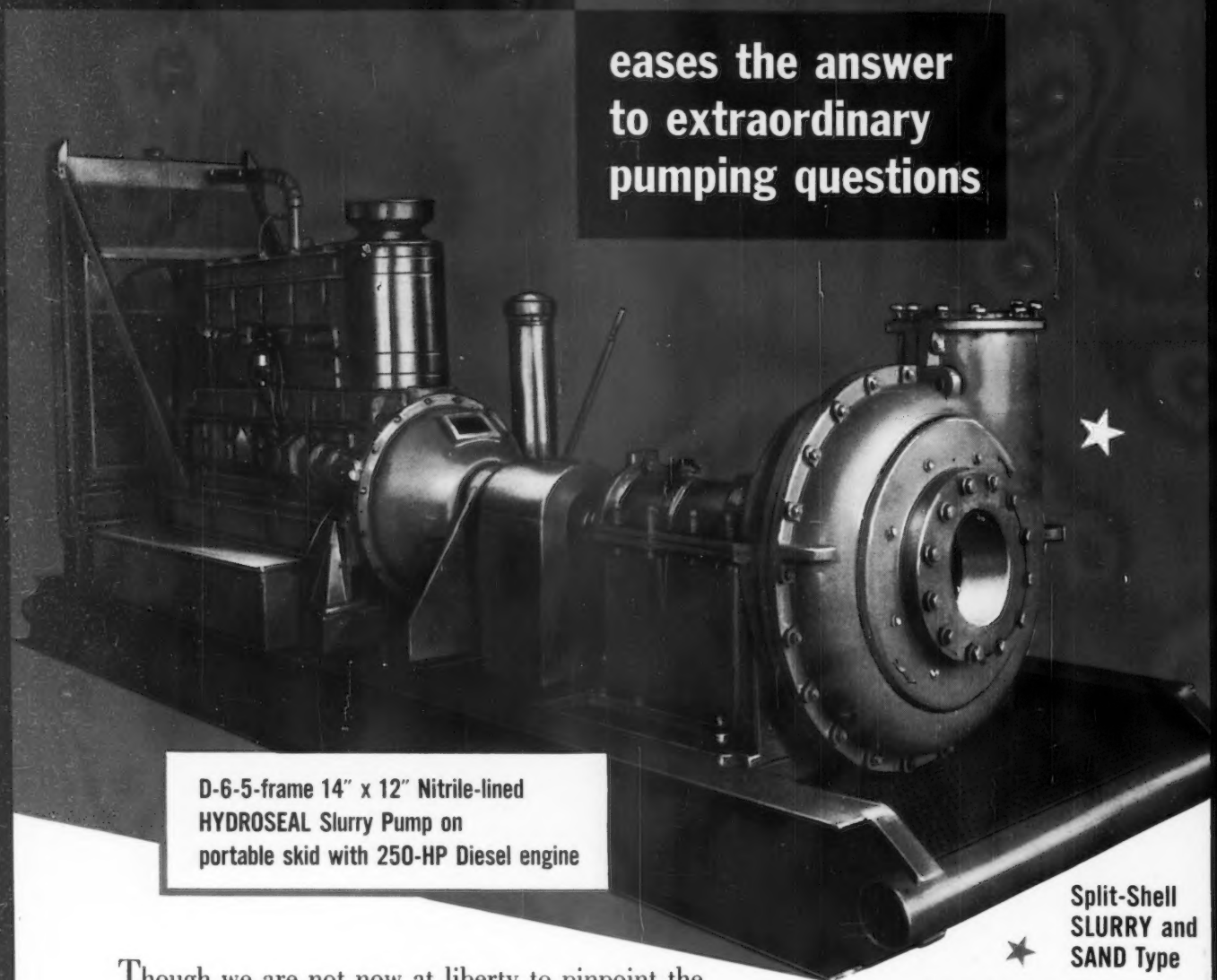
eases the answer to extraordinary pumping questions



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Though we are not now at liberty to pinpoint the application, this custom-designed unit speaks for itself as a product of experienced A-S-H engineering together with the flexibility of A-S-H pumps. Is it possible that the efficiency and economy of your pumping can be improved? Write us.

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HYDROSEAL *and CENTRISEAL*

SAND, SLURRY & DREDGE PUMPS

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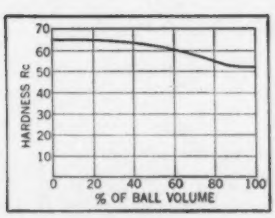
Immediate delivery on USS Grinding Balls We can ship immediately from stock as requested a range of sizes from ¾″ to 4″ in USS Carbon-Manganese and USS Alloy Steels. Here are three reasons why USS Grinding Balls should be specified: **Maximum hardness** combined with superior toughness. **Deeper hardness penetration** achieved by careful combination of chemical composition and heat treatment. **Uniform roundness** from ball to ball, load to load, for less wear and superior performance. If you have a delivery, performance, or selection problem, call our nearest Sales Office or United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.



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Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Export Company
United States Steel

USS

Mining Calendar

New Mexico Mining Assn.-Southwest International Mining Assn. annual meeting, La Fonda Hotel, Santa Fe, Nov. 3-5

Electric Furnace Conference, Morrison Hotel, Chicago, Nov. 30-Dec. 2

National Conference on Water Pollution, Public Health Service, Washington, D.C. Dec. 12-14

Light Metal Industry Symposium, National Metallurgical Laboratory, Jamshedpur, India, February 1961

AIME annual meeting, Chase-Park Plaza and Ambassador Hotels, St. Louis, Feb. 26-March 2

International Symposium on Agglomeration, Philadelphia, April 12-14, 1961

High Temperature Materials Conference, Cleveland Section, AIME, Hotel Pick-Carter, Cleveland, April 26-27

Commemoration of the 50th Anniversary of Froth Flotation in the U.S., sponsored by MBD of SME, Cosmopolitan Hotel, Denver, Sept. 17-20

Coming Up

Direct Reduction—One of the most progressive industries in the mineral field over the last decade has been iron and steel. Taconite and jasper mining and processing, sintering, pelletizing, flotation and heavy-media beneficiation have all been in the news as steel men have striven to improve the efficiency of their processes.

As is often the case, financial necessity in the iron and steel industry is the mother of invention. Declining reserves and rising costs of coking coal make it necessary to run blast furnaces ever more efficiently. One avenue that has drawn a vast flow of steel's research dollars is direct reduction—by-passing altogether the expensive-to-build, coke-needing blast furnace with a cheaper, more flexible device to extract iron metal from ore. E&MJ surveys the progress in direct reduction, describes the new and developing processes, and assesses how they seem to be fitting in to the over-all picture of iron technology.

Senegal Phosphate—After ten years of development, and intensive exploration and capital investment, a reserve of more than 40-million tons of ore is about to be tapped by Compagnie Senegalaise de Phosphates de Taiba.

94th YEAR OF PUBLICATION

ENGINEERING AND MINING JOURNAL

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Rubber takes pounding that wears holes in steel

BIG chunks of ore—some weighing up to 2 tons—crash down from that vibrating feeder to a wear pad below. This terrific pounding 8 hours a day, 5 days a week, quickly wore holes in a wear pad of ½" thick steel plate, caused frequent shut-downs for repairs and replacement.

To avoid these costly delays, a B.F.Goodrich distributor suggested a wear pad made of a rubber called Armorite, specially compounded to stand this sort of a beating. This rubber is soft enough to *give* under the pounding it gets, yet so tough that it is even used in some places to carry broken glass.

The Armorite wear pad stood up under the pounding for 14 months —six times longer than the steel plate. And the Armorite wear pad pictured at left, which replaced the first when it finally wore out, is expected to last even longer because of a different method of installation.

B.F.Goodrich Armorite can be used in dozens of ways—as a liner, curtain, throw mat for protection against abrasives. Can be ordered with or without a reinforcing back of fabric, fiber or steel. Your B.F.Goodrich distributor has full information on Armorite. And, as a factory-trained specialist in rubber parts, he can answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-913, Akron 18, Ohio.*

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Articles in this issue of

ENGINEERING AND MINING JOURNAL

Continued from p 2

24 The American Mining Congress meeting at Las Vegas

New and bigger equipment, new trends in mining and milling methods, spiced with the atmosphere of political contention . . . thus did AMC present its biennial "product" to the metal and non-metallic mining industry. While time does not permit immediate coverage of the entire program, the editors have arbitrarily chosen some highlights for this month's news section. There's more to come in future issues.

86 Transarizona Mines Copper Silicates

An old process, segregation, is used in the U. S. for the first time in treating silicate and mixed silicate-sulphide copper ores. Transarizona Resources Inc. is operating their plant south of Casa Grande, Ariz., near their open-pit mine. The 2% copper ore is fed through the plant at 15 to 20 tph. A rotary calciner, fired indirectly with natural gas, is the heart of the process.

88 Preloaded Concrete Pillars—Design and Construction

In order to prevent roof settlement and caving when replacing rock pillars, St. Joseph Lead Co. has developed a new-type concrete pillar. By preloading and prestressing the pillar, settlement of the roof (caused by natural loading on the pillar) is minimized. Although comparatively expensive, these pillars adequately safeguard important installations. Thanks to St. Joe's mine research department, data on both the design and construction of these pillars are now available.

94 Germans Make Building Stones from Mill Tailings & Flyash

Squeezing extra dollars from a process through utilizing products normally thrown on the waste dump is always a matter of interest to a company. Here is how one German company, which operates a lead-zinc mine and mill, coal mines, and a power plant, reclaims its tailings and flyash to make useful, high-quality building brick.

97 How to Estimate Voltage Drop in AC Mines

A fast, simple method has been devised to enable mine engineers to estimate voltage drop for AC underground distribution systems. Offered here is a set of formulas and tables that makes tedious computing unnecessary. Also included is a sample problem to show you how the method works.

100 Unique Conveyor Negotiates Steep Grades

Among the techniques introduced by the bucket wheel excavator is a conveying system designed to move mixed-size overburden up grades as high as 100%. On the sandwich conveyor, an upper belt, which prevents material from rolling back, is pressed elastically onto the carrying belt in order to increase the friction surfaces and assure a uniform flow.

104 An Electrical Designer Describes a Processing Plant

Since the proper use of electrical power in ore processing plants is increasing in importance as the need for more precise controls increases, W. E. Schwartzman of Allis-Chalmers' Industrial Systems department explains how this power need problem can be attacked and solved.

ALLIS-CHALMERS

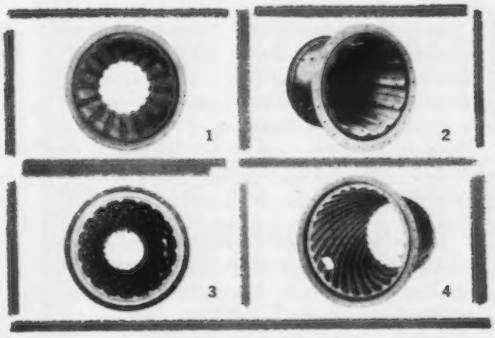
It takes at least four points-of-view

to create the shell liner that does the best grinding job for you

When A-C engineers recommend a shell liner for your grinding mill operation, you can be sure of one thing: it represents years of experience in all phases of mill operation. The first step in determining the right type is a four-point metallurgical and wear pattern analysis. Here are the four points:

First, the ore is analyzed for hardness and abrasiveness. Second, the fineness of grind is examined — a coarse grind requires lifting the grinding media high for impact; a finer grind calls for more abrading action. Then, the mill itself is studied to determine the size of balls or rods needed to accomplish the required grind. Finally, the metallurgical properties of the liner material are investigated to assure longer life.

The right liner lasts longer — and often increases the capacity of your mill. *Ask your A-C representative to look into your shell liner problems, or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin.* A-1366



These four types of liners demonstrate how liners can vary over a wide range of design characteristics to meet the specific requirements of a job. Pictured: (1) Lorain liner, (2) wave type, (3) wedge type and (4) spiral liner.

94 YEARS OF MINING

The following news items are reprinted substantially as they first appeared in the AMERICAN JOURNAL OF MINING, the publication which became *E&MJ*.

BRITISH COLUMBIA, MAY 1866—From San Francisco: New gold diggings, paying nine dollars per pan, have been struck on Clemens creek, near the Big Bend mines. Hundreds of boats are going up the Columbia river, laden with miners and provisions. It is rumored that the United States soldiers at Fort Colville have deserted and gone to the mines, taking their arms with them.

THE COMSTOCK, MAY 1866—The engine at the Sacramento is a fair offset to the balance due the foundry, which is about $30,000, and an overdraft of about the same amount. Had it not been for the error in the calculation of the engineer who directed the work in the drifts from the shaft, this mine would have a surplus on hand today.

CALIFORNIA, MAY 1866—It is said that a number of diamonds have been found lately, at Cherokee Ravine, Butte County.

MICHIGAN, MAY 1866—The Marquette MINING JOURNAL reports the discovery of two veins of silver lead, the Holyoke mine exceeding anything yet found in the Silver Lead Region. The ore is of a fine grain, and closely resembles the richest ever found in Colorado.

PENNSYLVANIA, MAY 1866 — A company of professionals are locating flowing wells at Hamilton. They are accompanied in their peregrinations by a wand of hazel, a number of pieces stone found on a rock in Enniskillen, and a full supply of brandy and crackers.

MINNESOTA, MAY 1866—The petroleum seekers at Red Wing recently sunk a well, which, being tested, was pronounced "a good pumping well." A watch was set by outsiders, and at night the owners were detected pouring oil into the well for the purpose of pumping it out next day.

This month in

ENGINEERING AND MINING JOURNAL

Continued from p4

Behind the By-Lines

When the roll is called, number us among the happy group which departed from Las Vegas loaded—with information, ideas and excitement about the future of the mining industry. (Okay, so we did ingest a little of the bubbly, too. But not enough to give us the glow that we got from the AMC meeting.)

It's hard to believe that an industry show could distract from the glitter of the famous Vegas strip, but we saw it happen. In fact Las Vegans themselves were asking if the public was permitted into the exposition hall.

It'll take us a couple of months to begin to compress the information we gathered at the meeting, or to begin to describe the equipment which dominated the scene, but we've started on p 24.

Speaking of the exhibition hall, a horseback survey of manufacturers proved our suspicion that the new structure in Las Vegas is one of the best of its kind in the world. And we learned from the designer of the building that Julian Conover of AMC himself had a hand in suggesting the layout.

We must confess that we had some fears about meeting attendance with a town with all the distractions of Las Vegas right on the doorstep. When we learned that registration at the convention hall was an all-time record, and saw the crowds of people at the sessions every day (even mornings!) we checked with some more seasoned observers for an explanation.

We found a seasoned (perhaps salty is the better word) observer at a local emporium of chance, where he dispensed pasteboards in the educational exercise known as vingt-et-un on the Continent, and blackjack where we come from.

"How come," said we, "that a convention can draw crowds when there is so much going on in this town?"

He paused, while we watched half the chorus line from the local PTA benefit stroll by, and said, "S'very simple . . . hit? . . . people go to the conventions . . . dealer pays 21 . . . because they know the town never closes . . . too bad, Mac . . . and they're not missing anything . . . anteup . . ."

Further dialogue ensued. We did not want to tear ourselves away from such a deep thinker and keen observer—and besides, he was into us for six bucks. We finally left, in the tradition of the seeker after truth and beauty, sadder but wiser.

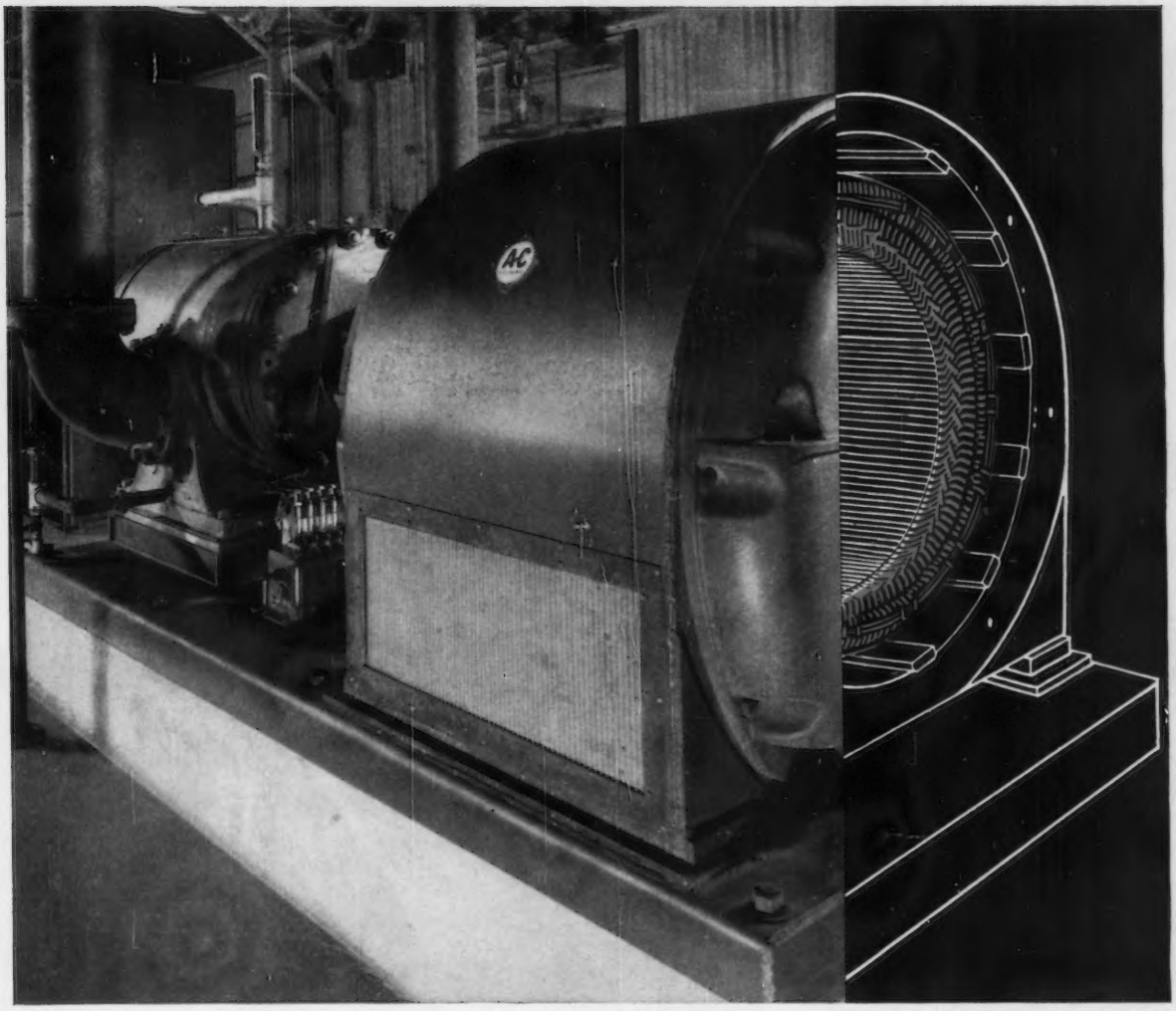
You'll forgive us, though, if we admit that the glittery goings-on and the general atmosphere of razzle-dazzle begins to pall after about two days. What troubles us is trying to figure if we're finally getting mature, or just getting old.

On our way back to the shop, via the Drilling & Blasting Symposium at Golden, we spent a delightful hour in the office of Al Hack, president of Hack Engineering Co., in Denver.

Mr. Hack had told us about a pilot plant process for producing yellow cake from schroeckingerite ore and invited us to see it (p25). When we asked to see the pilot plant, he modestly took some ore from under the desk, crushed it in a pestle, added water and a reagent, let it settle, drew off the solution, added a caustic and handed us a baby food bottle one-quarter full of yellow cake.

He later confided that his inspiration for the process came from an article in E&MJ which described schroeckingerite ore as "extremely difficult to process."

ALLIS-CHALMERS



Silco-Flex insulation in this compressor application provides complete protection against practically every enemy of motor insulation.

Your major motor investments are protected by Allis-Chalmers

invisible standards of perfection

Allis-Chalmers motors prove the value of thinking beyond established design standards. This thinking, applied to research, development and manufacturing, has led to advanced design features which mean greater application versatility, exceptional reliability and extended motor life. These are invisible standards of perfection you get with Allis-Chalmers motors.

Silco-Flex insulation, for example, has completely changed the rules on open-motor application. It is impervious to moisture, oils, and most acids, alkalies and solvents. It is resistant to abrasion, and is capable of withstanding high temperatures. Its resilience provides durability to withstand shock and vibration.

Super-Seal motors, with *Silco-Flex* insulation, have proved themselves for more than five years under the most severe conditions in industry.

Advancements such as capsule bearings, split end housings, and *Integrated* field coils (for synchronous motors) add to the superior performance of *Super-Seal* motors.

They contribute to the invisible standards that protect your motor investments year after year — cut replacement costs — assure uninterrupted production.

To learn more, call your nearby A-C representative, or write **Allis-Chalmers,** *Power Equipment Division, Milwaukee 1, Wisconsin.* A-1297

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FOR THE FACTS ON GENERAL ELECTRIC'S MOTORIZED WHEEL DRIVE . . .

Ride Lectra Haul on the Mesabi

The minute you climb aboard this latest challenger to the Mesabi's tough operating conditions, you sense the massive power and performance that's at your control.

Powered by General Electric's new Motorized Wheel Drive, Lectra Haul gives you maneuverability and grade-ability never before attained in rear-dump vehicles of its size.

The truck was built by Unit Rig & Equipment Company of Tulsa to satisfy the demand of users for a vehicle that would cut haul costs by combining maneuverability, capacity and performance. Electric drive makes this vehicle possible.

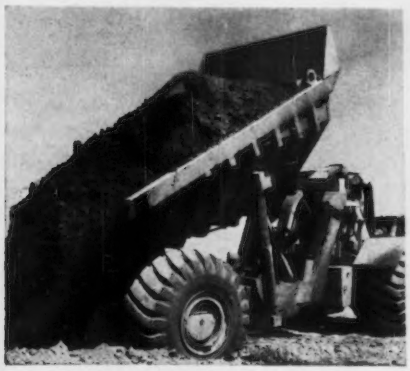
Here's how the new drive works: a traction motor is mounted in the rim of each wheel and bolted to the side of the vehicle . . . completely eliminating the need for axles, transmissions, differentials and drive shafts. Electric power for the Motorized Wheels is supplied by an engine-driven generator.

G-E's Motorized Wheel Drive is available in rim sizes from 29 in. to 45 in.

GENERAL ELECTRIC

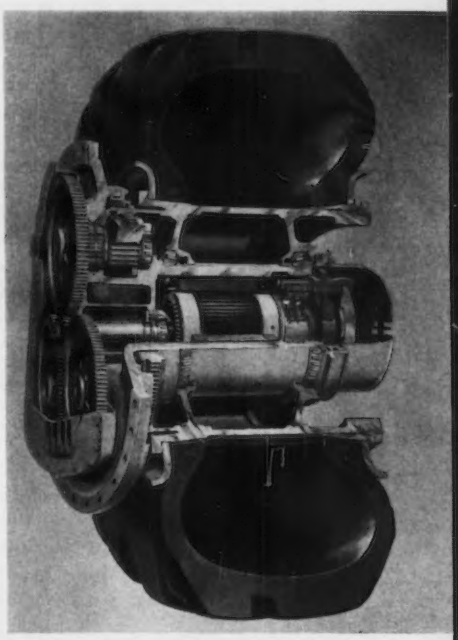
ALL-WHEEL DRIVE without separate engines, axles, transmissions, differentials, and drive shafts reduces maintenance, increases drive system reliability.

HIGHEST BRAKING CAPACITY without fading or mechanical wear results from dynamic braking allowing safe, high-speed operation.



64-TON CAPACITY with unmatched maneuverability and gradeability allows lowest cost per ton haulage, makes possible profitable mining of deeper pits and leaner ores.

SIMPLE OPERATION provides full control of traction and braking effort at all speeds, unequalled operating ease, safety, and maximum productivity.



PROPORTIONED POWER matches traction conditions at each wheel, providing more working hours under adverse weather conditions and terrain.

INCREASED GRADEABILITY through utilization of engine horsepower at all wheels permits operation over steeper grades at haul road speeds, reduces haul lengths and roadway maintenance.

GREATER MANEUVERABILITY because motorized wheel drive enables Lectra Haul to combine the maneuverability of a king pin steer vehicle with the gradeability of a "weight on drivers," rigid frame vehicle.

FOR COMPLETE INFORMATION on how G-E's Motorized Wheel Drive can help you cut your haul costs, contact your nearby G-E Apparatus Sales Office, or write Section 103-02, Schenectady 5, New York.

Progress Is Our Most Important Product

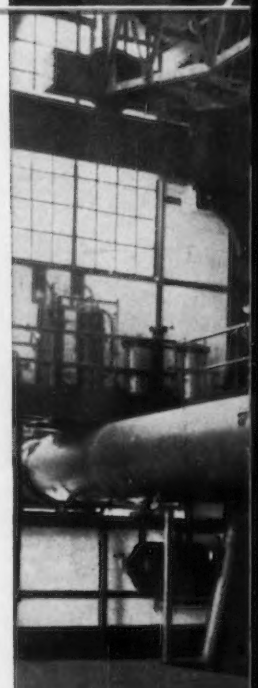
GENERAL ELECTRIC

from URANIUM in SASKATCHEWAN
to NITRATES in CHILE . . .

NORDBERG ENGINES
prove their reliability and economy
in MINING SERVICE

AT GUNNAR MINES, LIMITED . . . Neither bitter cold, nor inaccessible location could stop the successful development of a strategically valuable uranium ore deposit by Gunnar Mines, Limited, located in northwest Saskatchewan, less than 450 miles south of the Arctic Circle.

To meet the electrical power requirements for the construction and operation of mine, mill and town facilities, Gunnar chose seven Nordberg Supairthermal® 4-cycle diesel engine-generator units, each rated 1200 hp at 450 rpm, direct connected to 845 kw generators. Adding to the efficiency of this installation are waste heat boilers which utilize exhaust gas from the Nordberg engines to produce steam for heating plant buildings.



AT ANGLO-LAUTARO NITRATE CORPORATION . . . The story of power plant expansion for Anglo-Lautaro Nitrate Corporation's vast operations in northern Chile is largely a story of reliable Nordberg power. Their original Nordberg engine was a 7100 hp diesel unit installed in the Pedro de Valdivia plant, followed by the installation of two 1900 hp Nordberg diesels for the plant at María Elena. Then, to meet much needed additional power, two big 9600 hp Nordberg diesels were installed in a new power plant at Coya Sur.

Now Anglo-Lautaro has again turned to Nordberg to meet further power expansion, and has ordered *five more* Nordberg diesels, each rated 5750 hp, to be installed in the Pedro de Valdivia power plant. When these new engines are put in service, the combined generating capacity of all ten Nordberg engines will provide over 38,000 kilowatts for nitrate production.

While these installations in Saskatchewan and Chile are widely separated geographically, they serve as striking examples of the way in which Nordberg engines are serving the varied power requirements of the mining industry . . . especially in remote areas where dependable operation is of prime importance.

NORDBERG MANUFACTURING COMPANY
Milwaukee 1, Wisconsin

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P959

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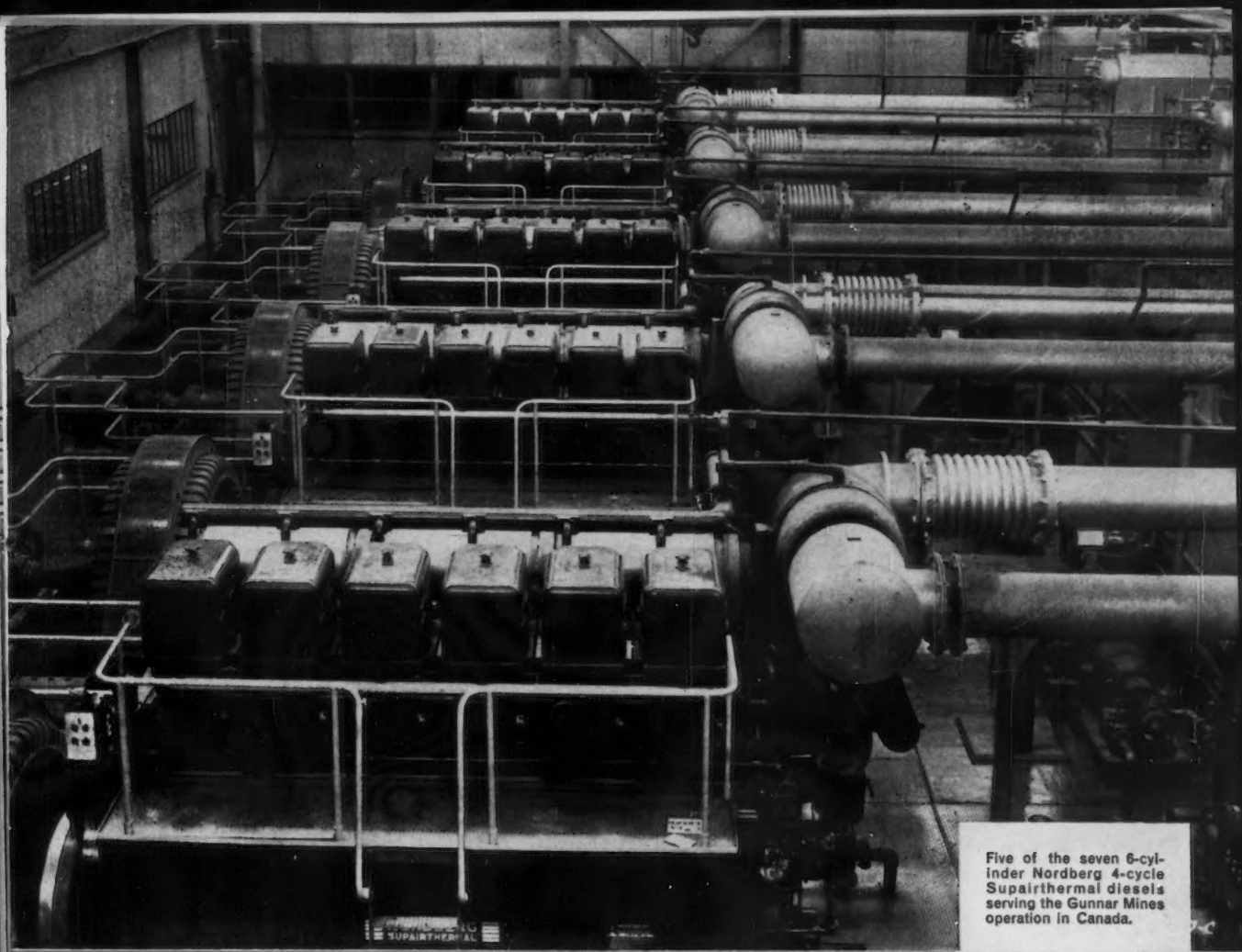
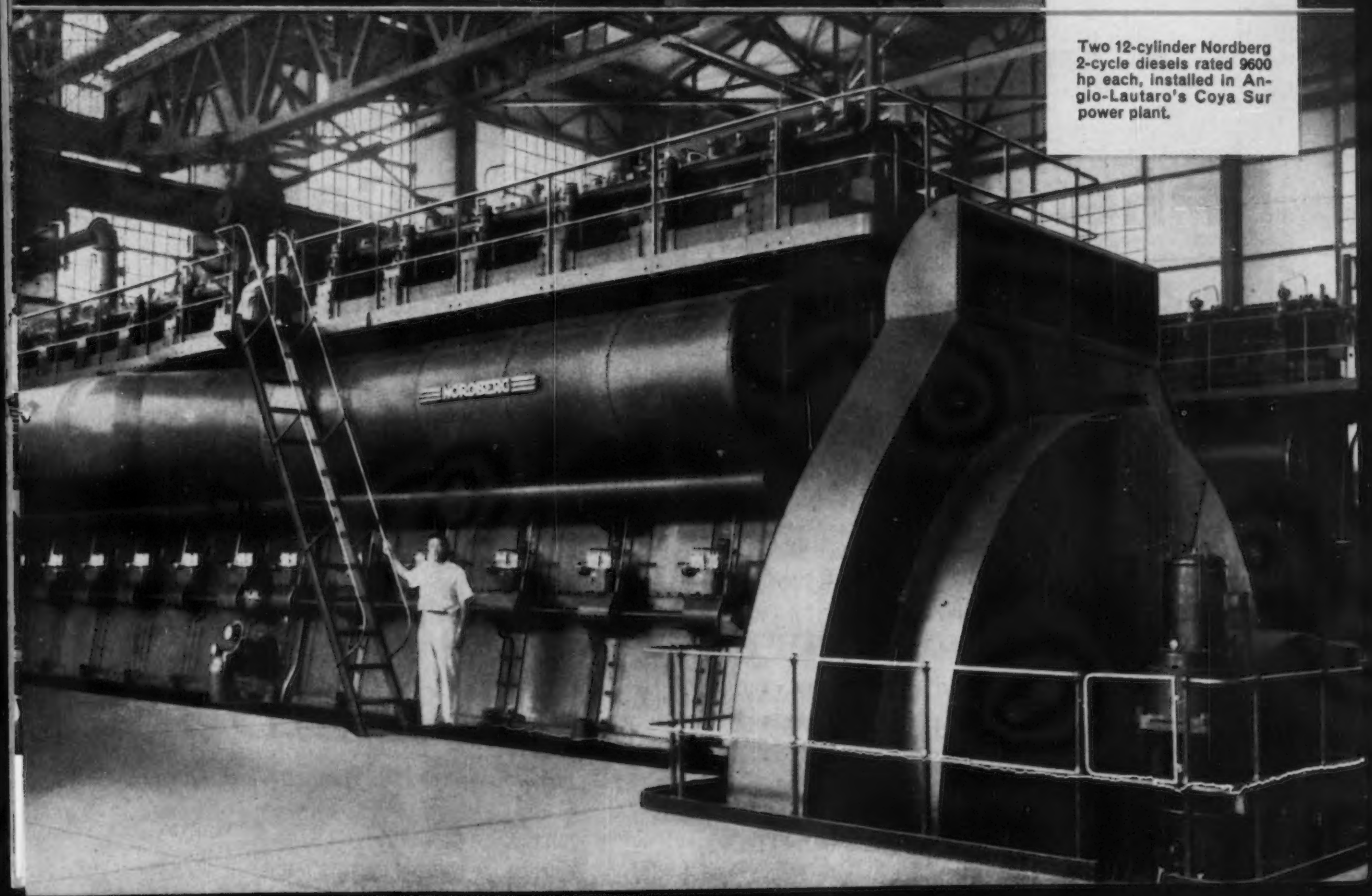


Five of the seven 6-cylinder Nordberg 4-cycle Supairthermal diesels serving the Gunnar Mines operation in Canada.



Two 12-cylinder Nordberg 2-cycle diesels rated 9600 hp each, installed in Anglo-Lautaro's Coya Sur power plant.

SELECT THE CABLE MADE BY THE FAMOUS "MINE-TO-MARKET" FAMILY . . .

Phelps Dodge Mining Cable

- Made of highest quality copper from Phelps Dodge's own open-pit mines.
- Combines years of Phelps Dodge mining "know-how" with many years of cable manufacturing experience to give you the finest quality cable you can specify.
- Assures utmost protection against damage from mechanical and electrical hazards in both above and below ground mining operations.
- Listed by the U. S. Bureau of Mines, and approved by the Department of Mines, Commonwealth of Pennsylvania, P-114-BM.

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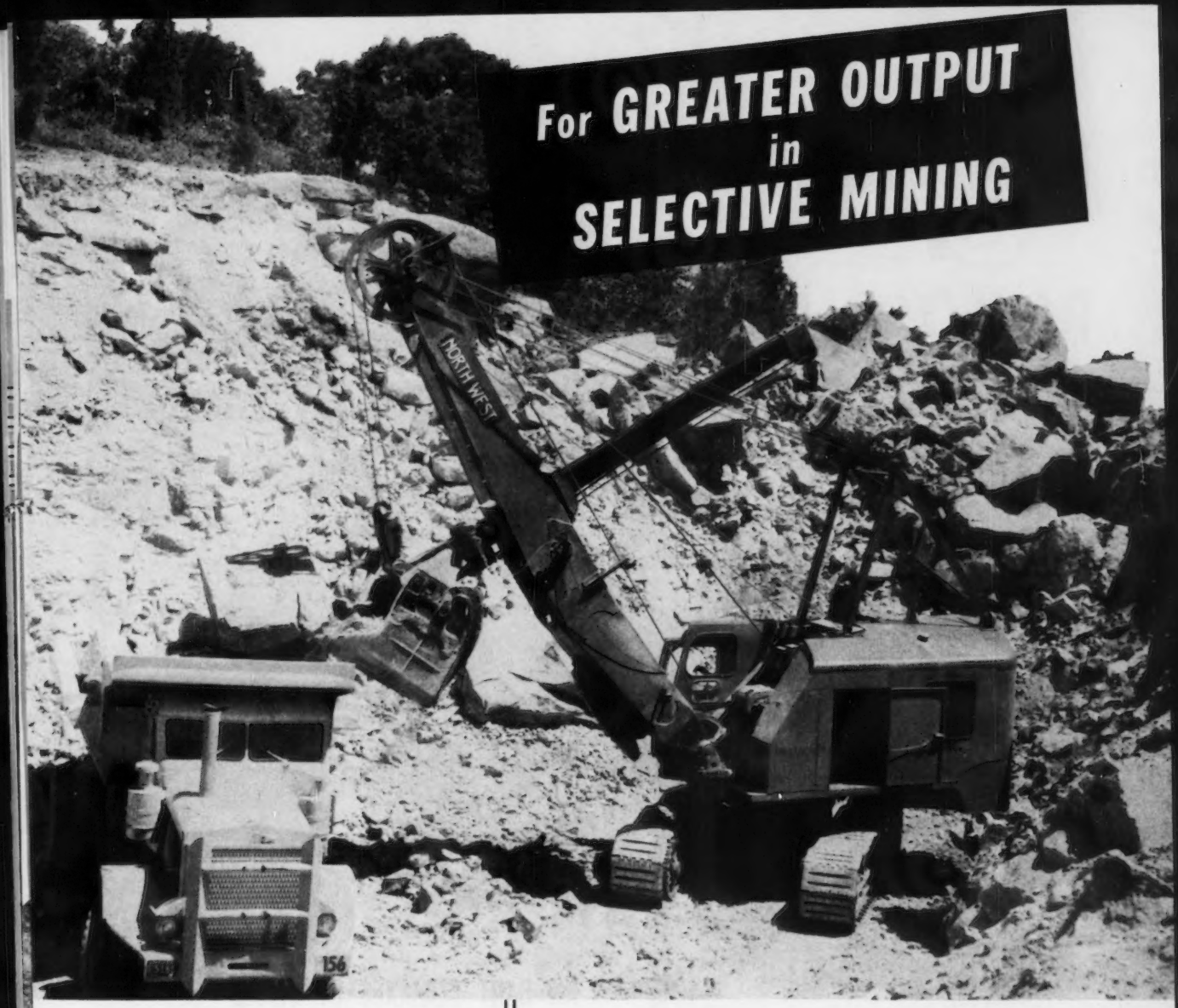
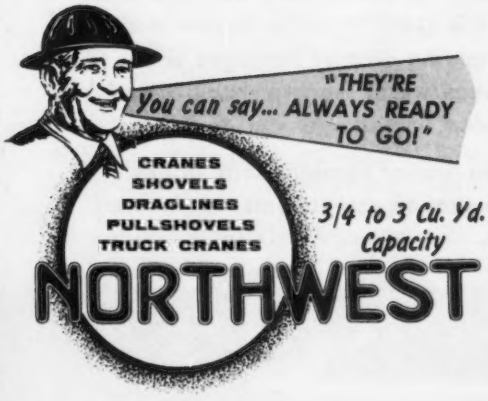
CORPORATION
300 Park Avenue, New York 22, N. Y.





Northwest Shovels and Draglines are proving highly profitable in this day when some of the most highly valuable ore is being found in the relatively small lenses. The Northwest 80-D, 2½ yard Shovel or the Model 95, 3 yard Dragline bring you good capacity and at the same time they are small enough for selective mining.

They meet the problems that arise in the wide variation of work they have to do, and at the same time bring you machine quality that assures dependability in the distant locations characteristic of most mining operations. Your Northwest travels easily from one location to another and positive traction on both crawlers while turning as well as when going straight ahead easily negotiate soggy going. A Northwest moves in and out of pockets and loads to trucks in box end cuts without fouling the wall and with the minimum of spillage.

The Model 95 Dragline easily handles long booms and has profitably removed twenty feet of overburden for each foot of ore uncovered.

Northwest shovels have trailed large capacity rigs and profitably loaded out rich pockets of iron ore on the range.

If you need a fast, mobile rig in your pit, you should learn about Northwest advantages. There are many exclusive features that assure high output and freedom from "down time."

NORTHWEST ENGINEERING COMPANY

1509 Field Building • 135 South La Salle Street • Chicago 3, Illinois

S-80-18-L

NEW PEAK in PAYLOAD!!

Introduced at the Mining Congress Convention this October, KW-DART'S 95EDT is the company's latest contribution to the mining industry. Its payload is 95 tons.

This tractor-trailer, the 70EDT, is a 70 ton hauler that has established enviable performance records in a number of mines in recent years.

The 50EDT carries 50 tons as a tractor-trailer. It utilizes KW-DART'S popular 25SL as a tractor. Its enthusiastic approval by mining operators fostered development of the larger units.

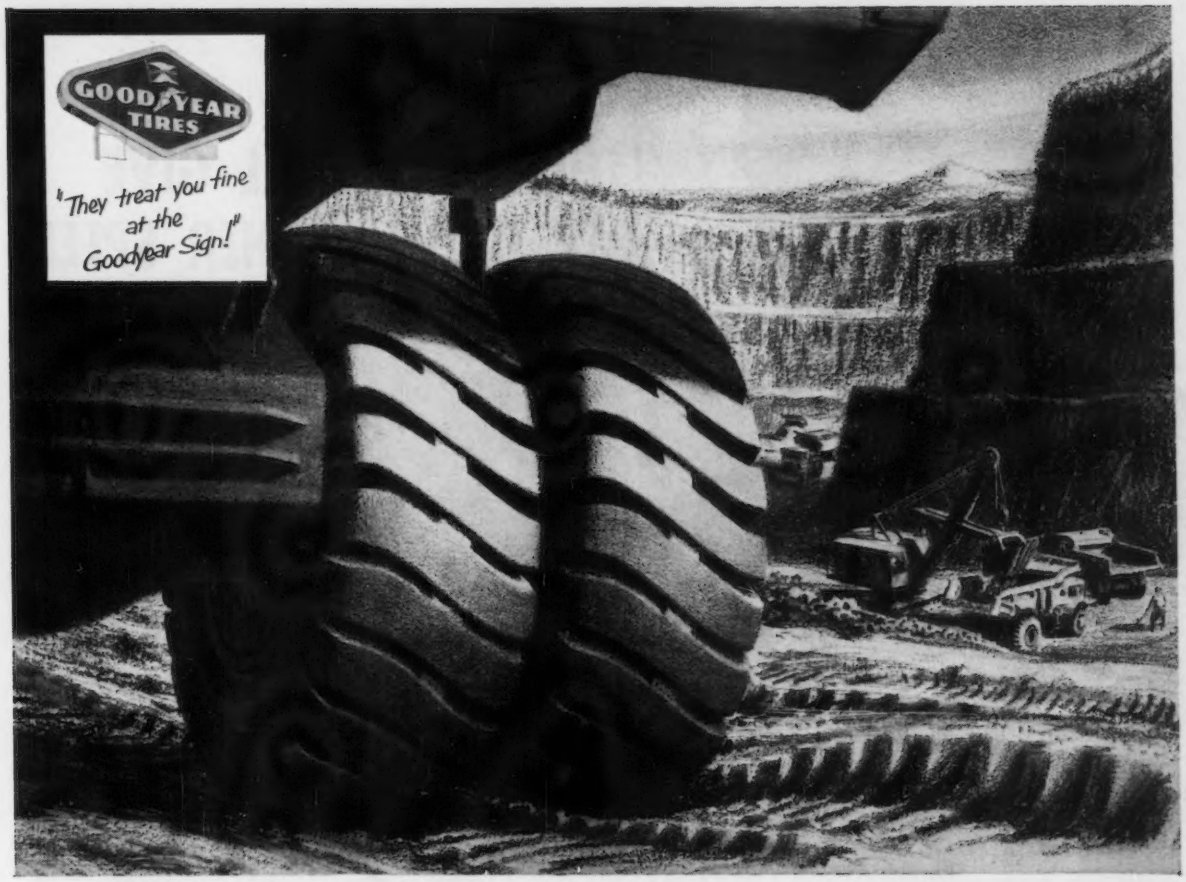
KW-DART CLIMAXES 57 YEARS OF ENGINEERING WITH THREE HIGH CAPACITY TRACTOR-TRAILERS

A new concept in heavy duty haulage was born with KW-DART'S tractor-trailer design. It enables moving greater tonnages with negligible sacrifice of maneuverability and without added horsepower.

These tractor-trailer combinations utilize KW-DART'S proved components, *engineered to your job.*

KW-DART TRUCK CO.®

1301 North Manchester Trafficway • Kansas City 41, Missouri, U.S.A.



You never had 'em so tough!

HARD ROCK LUG XTRA TRED

Here it is! From Goodyear's advanced technology and processes—

HARD ROCK LUG XTRA TRED—the mine and quarry tire that's built with extra tread to take it where the going's tough!

It's made with 3-T Nylon Cord—triple-tempered by Tension, Temperature and Time—that makes *the world's toughest tire bodies.*

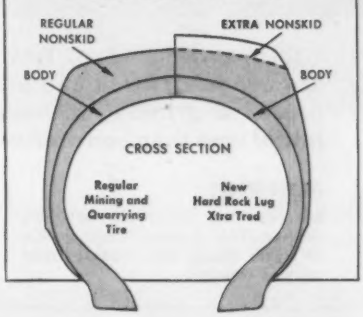
It has specially compounded rubber that embodies remarkable super-toughening agents for far greater chip-, wear- and penetration-resistance—that produces *the world's toughest treads.*

And, with its thicker nonskid tread depth (as much as 71% thicker) for harder-biting, longer-wearing lugs, you take out *more pay loads in less time and at lower cost*—with fewer maintenance headaches, too!

Ask your Goodyear dealer about Hard Rock Lug Xtra Treds, *now.*

Goodyear, Truck Tire Department, Akron 16, Ohio.

MORE AND TOUGHER RUBBER IN THE RIGHT PLACES!



THE WORLD'S TOUGHEST TRUCK TIRES BY

GOODYEAR

Xtra Tred—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

"THIS GEAR WILL GIVE MY DRIVE HIGHER SPEED PLUS LONGER LIFE..."

Utilizing the modern facilities in our newly equipped plant, higher speed and longer life are just two of the advantages that you will get with Philadelphia's revolutionary precision grinding technique. Very often these advantages are available at no more initial cost than conventional gearing.

HIGHER SPEEDS

Dynamic load factors are materially reduced. Your equipment can operate at higher speeds with increased load carrying capacity.

LONGER LIFE

Extreme accuracy of profiles, profile spacing and surface finish eliminates "running-in" periods and resulting wear.

REDUCED NOISE AND VIBRATION

Reduced tooth to tooth errors, accumulated pitch errors, and total composite errors give smoother contact . . . reduce noise and vibration.

REDUCED BACKLASH

Precision ground gearing means reduced backlash for reversing drives . . . plus uniform backlash where precision of movement is important.

100% INTERCHANGEABILITY

Duplicate units or spares can be installed with original manufacturing tolerances duplicated exactly.

FOR MORE INFORMATION

. . . investigate this modern technique. Send for our new bulletin, AN ADVANCED CONCEPT IN MODERN GEARS.

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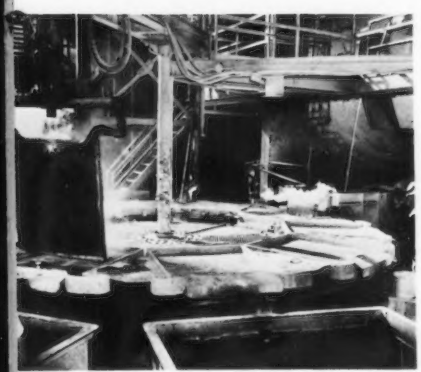
PHILADELPHIA GEAR CORPORATION

King of Prussia (Suburban Philadelphia), Pennsylvania

from mine and pit to mill and smelter...

WESTINGHOUSE PROGRESSIVE AUTOMATION CAN HELP YOU STEP UP TONNAGE WHILE CUTTING COSTS



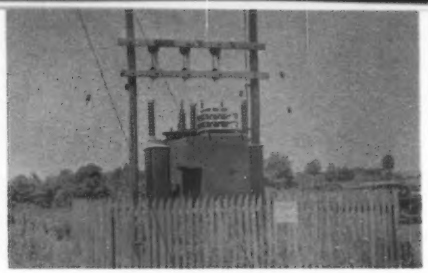
A highly reliable and efficient electrical system must hold a top priority in your equipment planning. You can achieve such a system through Westinghouse *Progressive Automation.*

Progressive Automation is a Westinghouse concept to help you plan economical steps to automatic production. Westinghouse engineering facilities are available, for example, to help plan a substation, lay out a plant distribution system, or develop a computer program. Any such planning should be twofold: to meet present needs and to foresee future expansion and growth.

Look over the following pages for some of the Westinghouse equipment now contributing to more automatic, less costly and more efficient production.

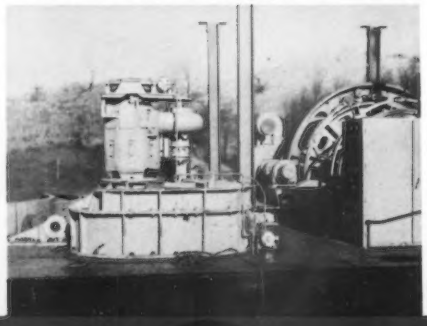
Westinghouse

Power distribution starts with dependable Westinghouse UNIT SUBSTATIONS, which are shipped completely assembled and pretested. Their compactness makes them ideal for mining operations because they can be moved as mining progresses.



Portable Westinghouse SWITCH HOUSES, to control and protect the high-voltage circuits to portable mining equipment, provide safety and continuity of service features. Reliably designed safety circuits guard personnel against hazardous conditions.

The trend of the industry in removing overburden is toward excavating equipment of greater capacity. Faster work cycles at heavier duty place unusual demands on motors and control. Westinghouse SHOVEL MOTORS and M-G SETS have the stamina to give years of highly productive service . . . to help you get maximum tonnage out of every shift. In addition, Westinghouse supplies all-static-control assemblies, marking a new era of dependability in shovel performance.



open pit mining

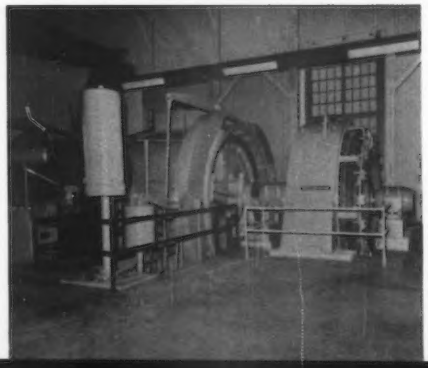
underground mining

crushing

Westinghouse sealed mine POWER CENTERS safely and reliably step down incoming power to utilization voltage levels. Nitrogen-filled, silicone-insulated power centers are completely protected from contaminating atmospheres.

Movement of material from deep-mines and open pits to the surface emphasizes the critical role of the modern mine hoist. Efficient power distribution systems and dependable HOIST MOTORS and STATIC CONTROL contribute to lower cost hoisting.

Westinghouse LIFE-LINE® "A" INDUCTION MOTORS drive slusher hoists. In addition, Westinghouse supplies d-c motor-generator sets, motors and controls for slushers.



In crusher applications, Westinghouse wound rotor MOTORS provide the high breakaway torque required to handle a large process mass, particularly in cold weather—and with less current inrush than squirrel-cage motors. The F/A MOTOR (foreground) with exclusive Thermalastic® insulation is fully accessible and makes for faster, easier inspection.

one source, one responsibility...

A WESTINGHOUSE COORDINATED ELECTRICAL SYSTEM IS TAILORED TO YOUR PROCESS EVERY STEP OF THE WAY

The mining operations and Westinghouse power distribution and utilization equipment (illustrated) are typical of the industry. Safety, reliability and continuity of mining operation have been paramount considerations in the design of these system components. Complementing this apparatus, Westinghouse data logging, programming and computer equipment can help even further to make plants more efficient.

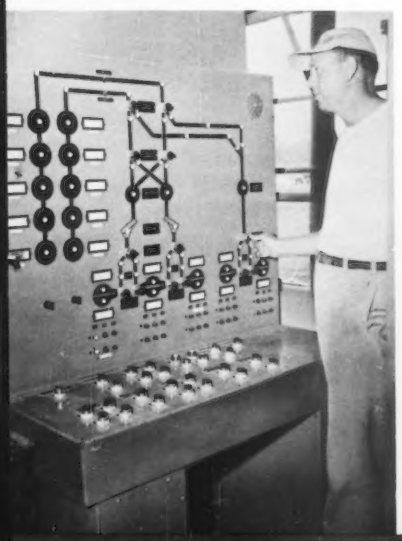
Your program for automation actually starts with the drive, control and power distribution components of your present system. Then you add new Westinghouse equipment, taking advantage of the latest product developments and control techniques. The next step is with Westinghouse coordinating control systems, utilizing data logging and other devices. Each stage of automation has been preplanned to meet immediate and future objectives . . . to increase total production, introduce quality improvement measures, or control high-cost areas of production.

WESTINGHOUSE PROGRESSIVE AUTOMATION... A LOGICAL PLAN FOR INCREASING PRODUCTION

Through years of experience developed through close association with your industry, Westinghouse has helped solve the problems of mining and processing huge quantities of ore . . . economically. Westinghouse is prepared to undertake analysis and study leading to the recommending, furnishing, installing and maintaining of equipment. For more information on *Progressive Automation*, call your Westinghouse representative. You can be sure . . . if it's Westinghouse.

Westinghouse

AUTOMATIC CENTRALIZED CONTROL permits an operator to follow flow of ore from one processing step to another through indicator lights. This sequence control affords an interlocking system for a group of conveyors. Such control reduces chance of human error, increases output, and improves product quality with substantial savings.



Classifier drive and flotation cell drive requirements vary with process
require the use of squirrel-cage motors. The Westinghouse SQUIRREL-
of strong, trouble-free construction. New Guardistor* motors provide
based on winding temperature . . . let you match the full capability of moto
of enclosed motors meets severe conditions encountered in abrasive atmos

*Trade-Mark

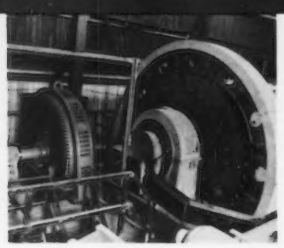
conveyors

grinding

concentrating

Westinghouse has wide experience in designing drives for conveyor systems for maintaining continuous flow. One of the newest is the MAGNAFLOW* electromagnetic drive suitable where soft starts or adjustable speed is desired. Westinghouse motor, speed reducer and control give dependable, trouble-free performance.

*Trade-Mark



Ball mill drives must be engineered to provide the critical starting torque, without upsetting the stability of the power system. Westinghouse SYNCHRONOUS MOTORS with the new STATIC SLIPSYN® CONTROL provide a drive with maximum reliability, minimum maintenance.

Westinghouse LOAD-O-MATI
TROLS use saturable reactor-cont
induction motors to provide the
required for fine crane control, es
and close bucket drives. Specific
heavy-duty design for reliability, st
static components; front wired, fro

*Trade-Mark

The Westinghouse AV DRIVE, employing an all-static magnetic amplifier regulating system, provides the most advanced drive for casting wheel drives to insure smooth-surfaced anodes. Two principal advantages are automatic stepless acceleration and deceleration, and accurate wheel positioning. Latest design Type AVR (Reactifier) DRIVE gives wide speed range and stepless speed control . . . uses power Magamps for efficient, static power conversion.

ocess flow but normally
REL-CAGE MOTOR is
ovide positive protection
motor to the job. Design
atmospheres.

Modern kiln operations have forced the replacement of wound rotor motors with more efficient adjustable speed drives. Westinghouse offers a complete selection of these drives. One drive with unique characteristics is RECTI-FLOW*. It has low inrush currents on startings and is available either as a constant horsepower or constant torque device with up to 3:1 speed range and low speed efficiencies of about 75%.
*Trade-Mark

Westinghouse FURNACE TRANSFORMERS competently handle exacting and varied current and voltage requirements. These units bring power to melting processes more economically and use it more efficiently for a net increase in production and reduction in power costs.

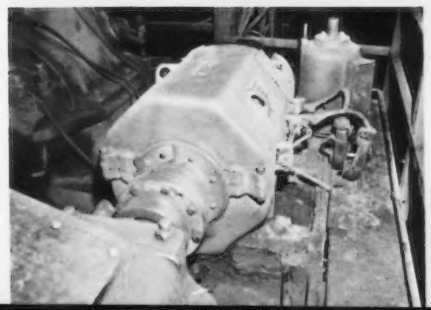
ing

smelting and refining

product

ATIC* CRANE CON-
r-controlled, wound rotor
e the speed adjustments
ol, especially in the hold
cific benefits are: rugged,
ity, stepless speed control,
d, front accessible.

To supply large blocks of direct current to electrolytic refining cells efficiently, the Westinghouse silicon rectifier is the ideal answer—at any voltage. Power savings on an installation are substantial. Recently, Westinghouse installed the world's largest SILICON RECTIFIER unit, rated 10,000 amps, 600 volts d-c, for a large metals producer.



Westinghouse silicone-insulated MC MILL MOTORS are engineered to meet demands of rough duty such as tipping electric furnaces used to convert metals. Improved field coil design provides greater capacity and longer life, while shaft and bearing design withstands heavy shock loads. SA BRAKES, applied on the extension of motor shaft, give accurate positioning.

Westinghouse

PRODUCTION RELIABILITY ASSURED WITH WESTINGHOUSE MAINTENANCE SERVICE

To help keep your plant operating at a profit, Westinghouse offers "Modern Maintenance." This is not a substitute for your own preventive maintenance program, but is designed to supplement it. By coordinating our program with yours, you can be assured of securing the lowest cost and most effective maintenance.

Modern Maintenance includes inspection, testing, modernization, field service, shop repair, and renewal part recommendations backed by highly trained specialists, up-to-date facilities and all the benefits of Westinghouse research and development.

Our maintenance specialists are men who know about the maintenance of electrical, electronic or steam equipment. When they repair a machine, they check it thoroughly—both electrically and mechanically so that your equipment is not only repaired, but modernized. For example, when these men rewind motors, they can use revolutionary insulation processes such as Super COILIFE* or Thermalastic that give motors extra life.

Fast repair service is available from our 42 Repair Plants that are equipped with the latest facilities and processes, with skilled craftsmen to rebuild and modernize your equipment. Fast shipment of renewal parts is assured from our 46 warehouses strategically located in industry centers. You can be sure . . . if it's Westinghouse.

Westinghouse

*Trade-Marks

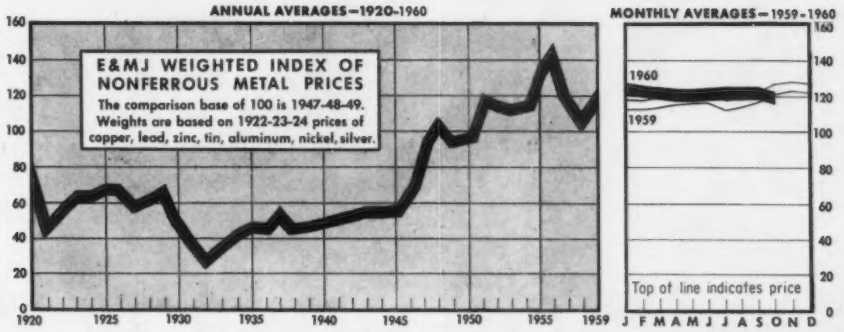
JI-96153

Polyester glass banding is applied to armatures and wound rotors of various ratings with a special Westinghouse-developed tension device, insuring a strength factor equal to steel.

Fast, one-day delivery for renewal parts is guaranteed when you order from your local Westinghouse warehouse.

E&MJ OUTLOOK

PRICES



MARKETS

E&MJ's nonferrous metals price index reflected the first significant decline in many months, dropping from 126.0 for September to 122.2 for October. Lower copper prices accounted for the decline. Tin increased 1c, other metals were unchanged.

Early expectations of major steel producers for a substantial upturn in demand during the fourth quarter have faded. They now predict that no material pick-up in demand will occur until about mid-1961.

●

AT HOME

Brush Beryllium Co.'s heavy expansion program will double the company's 1959 capacity by the end of 1961.

The Atomic Energy Commission will build a $4.1-million experimental reactor which will use a molten salt of uranium as a fuel. Constituents of the molten fuel are uranium fluoride dissolved in a mixture of lithium and beryllium fluorides. Although this design was originally developed for nuclear-powered aircraft, current objectives are to develop this advanced design for economic civilian power production.

The recent flurry in gold speculation on the London market became a political issue in the U.S. presidential campaign. Both candidates accused opposing parties of supporting faulty economic policies which threatened world confidence in the dollar. Both candidates pledged that they would maintain the current value of the dollar by opposing an increase in the world price of gold. Bankers and businessmen in England and on the Continent have consistently held the opinion that a sound undevaluated dollar is vital to stability in international trade and commerce. Shrinkage in U.S. gold holdings totaled $983-million during the first 10 months of 1960. Total drain during 1959 was $1,076-million of which $344-million was the U.S. payment to the International Monetary Fund.

●

LABOR

The growing battle between workers and the machine may be resolved in part by a tripartite Presidential Commission instructed to come up with a solution on automation problems in the transportation industry by the end of 1962. See p 27.

●

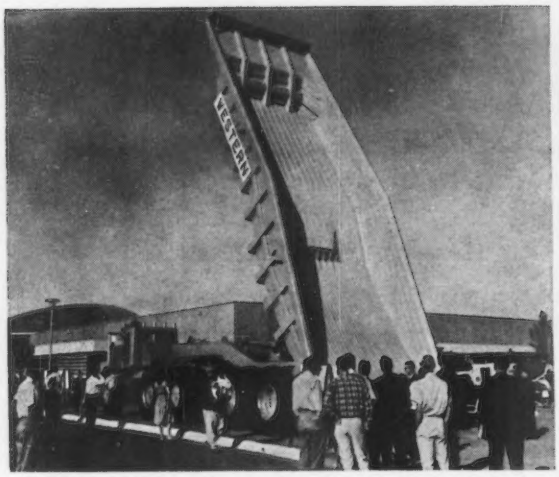
ABROAD

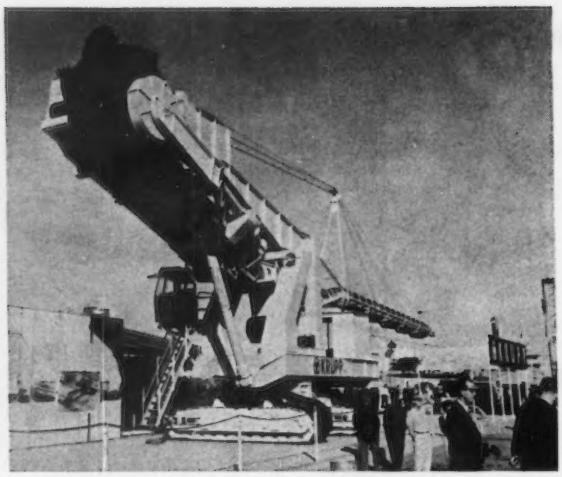
An oil drilling project in the Unterweser region in Lower Saxony, West Germany, unexpectedly penetrated a substantial iron ore deposit at depths of 266 to 1300 ft. The ores are comparable to those of the Salzgitter deposits and will require beneficiation.

TASS reports the development of an automatic mining combine which breaks, loads, and hauls manganese ore from seams up to 7.4 ft thick. The Soviets say that it is operated by one man and has a capacity of 1,300 tons per day.

TASS also reports that Ukrainian researchers are using electronic computers to analyze magnetic and gravitational geophysical anomalies. It is claimed that the computers yield information on the depth of occurrence, thickness, shape and other characteristics of orebodies.

THIS MONTH IN MINING





INNOVATION AND SIZE were the dominant points at the equipment show of the American Mining Congress meeting in Las Vegas last month. Western Contracting's 175-ton capacity truck and the Krupp digging wheel epitomize the idea.

AMC Show Breaks Records in Interest, Vitality

MORE THAN 7,500 MINING MEN attended the biggest and best of the American Mining Congress' Mining Shows, in Las Vegas, Oct. 10-13. Extraordinary interest was generated by the volume of the exhibit, and particularly by the size of much of the equipment shown. A mammoth orange 175-ton capacity truck constructed by Western Contracting Co., and presently in use at Kennecott's Bingham pit, was the first sight for visitors approaching the convention hall, and, in effect, struck the keynote for the whole show.

The excellent program of papers and speakers at the meeting began with the traditional discussion of national minerals policies. With election day then only a few weeks away, most of the leading figures in Washington who are concerned with mining and its future were present. But a discussion by representatives of the two major parties on their respective philosophies brought little that was either new—or of much consolation—to those segments of the industry which had been looking to Washington for help through difficult times. (See Washington Impact, p 26.)

Publication schedules do not permit complete coverage of the show and the papers in this issue. The following is a summary of some of the highlights, more will appear in next month's issue.

"The strategic metal industy in the U.S. has reached, or will reach in the next few months, the production levels of 1939. We are again the 'have not' nation in strategic metals that we were before World War II." Thus did Sam Williston, executive vice president of Cordero Mining Co. introduce a narrative of the depressed conditions which exist in the strategic metals industry. The grim tabulation included the information that antimony production in the U.S. "is limited to by-product metal from Idaho . . . 5% of domestic requirements" . . . that the only primary cobalt producer in the U.S. has closed down . . . that domestic production of chromite is limited to the Mouat, Mont. mine, whose Government contract expires in 1961 . . . that the only producer of "appreciable amounts" of columbium in the U.S. discontinued production this year . . . production of manganese has declined drastically . . . U.S. mercury production declined 20% during 1959 and will probably drop another 20% in 1960. The only cheerful note cited by Mr. Williston was in tungsten, which enjoys an import duty of more than 10% ad valorem, and which has three major producers in operation, and two more announced coming in.

Mr. Williston, who has maintained a strong touch of humor in spite of the current low estate of his industry, provided the wry comment which summed up the general dissatisfaction the industry feels toward both major political parties and what seems to be their attitude toward mining. When Sen. Frank Moss (D.-Utah) and Sen. Thruston B. Morton (R.-Ky.), chairman of the Republican National Committee, had completed their addresses to the convention, the latter with great humor and charm, but with little concrete hope for betterment of mining in general, Mr. Williston observed that the mining industry was up for grabs (politically) "to the highest bidder. But nobody's bidding."

A new approach to management's concept of maintenance—in one case the open pit—was introduced by R. Y. Jensen, assistant chief engineer, M. A. Hanna. The responsibility for the maintenance attitude of the work force, Mr. Jensen feels, eventually winds up with management and the superintendent before it gets to the foreman. A working team, dedicated to good housekeeping and top-shape equipment, can soon be discouraged and lose all dedication to maintenance if it sees management demanding more and more production at the expense of careful use of machinery.

Among other concepts cited by Mr. Jensen were: the encouragement of manufacturers to build machinery designed to facilitate repair and overhaul. "Everyone here has been exasperated by the sight of a $60,000 truck rendered useless during repair of some $25 component that could not be quickly removed for repair and replacement;" and constant attention and evaluation of records. "Information (based on records of equipment performance) can help convince management that improved equipment will reduce maintenance and reduce over-all costs."

Mr. Jensen also asked that the purchasing department maintain close liaision with the maintenance department to improve its own judgment in ordering replacements and new equipment. In summary, the speaker asked that the existence and needs of the maintenance department be kept in mind by all management, all supervisors and purchasing executives.

After modest early successes with instrumentation and automation in regard to processing temperatures and controls at its Arizona plant in 1948, the California Portland Cement Co. decided to concentrate on such practices in the

construction of the Mojave plant, according to R. G. Patterson, production manager. In a process which demands close attention to product storage and flow, sizing, quality and condition—as well as temperature, the use of sensing and recording devices (instrumentation) and automatic control equipment (automation) has proved very successful in most instances, genuinely helpful in some others and not easily workable in a few.

In the latter case, the company is sure that difficulties can be overcome and profitable application effected with greater study of the problem. California Portland is working closely with equipment manufacturers to get full benefit from the program.

Despite a warning to his audience that the cost of such a program is high, and that it places a grave responsibility upon management to supply qualified personnel to the project, Mr. Patterson feels that the imposition of automatic controls upon the process has succeeded in "extending the senses of the operator" through TV cameras, analog computers, recorders and controls. The benefits include collection of data for better evaluation of the process, release of the operator from routine tasks, more careful guiding of the process, tighter control from a central point, and generally improved communications.

A relatively new technique in strip and open pit mines, angle-face drilling, that is reported to result in lower-cost blasting, better fragmentation, and more stable banks, is possible with a rotary blast hole drill introduced by Joy Mfg. Co.

Available for either electric or diesel power, the Joy 965-BH Champion incorporates many automatic controls for fast set-up time. It can drill holes vertically or up to 30° from vertical, swings independently of crawlers, and provides push-button shifting of gear ratios in overhead drive.

A series of slurry blasting agents, D.B.A. (Dense Blasting Agents), that contain water as part of their composition, that are water compatible and may be left in water-filled holes for considerable periods of time, was featured by Intermountain Research and Engineering Co.

Because of the unusually high strength of slurry blasting agents, their high density and relatively low cost; large savings are often possible; especially in rock in which drilling costs are high and poor fragmentation is prevalent, according to the company.

The company also reports an increasing trend toward the use of D.B.A. as a "plaster" for secondary blasting, to avoid the high cost of drilling, since it is the highest velocity blasting agent available in addition to being the safest and most economical blasting agent for this purpose.

(*News continues on p 120*)

As We Went to Press . . .

Camp Bird Mine, in southwestern Colorado, has resumed production following a $2.6-million rehabilitation program begun in 1956. The mine, which has produced more than $50-million in gold and other metals since its discovery in the 1870's, has an estimated ore reserve of 777,000 tons. A contract for lead, copper and zinc concentrates from the new 500-tpd mill has been signed with American Smelting & Refining Co.

Katanga is going ahead with its expansion program despite the complex political situation, according to a special E&MJ correspondent, who noted that Union Miniere expects to produce 300,000 metric tons of copper this year and remains "extremely confident" for the future.

The major effect upon the mine of the current upheavals, so far, has been the alteration of shipping routes. About one-half of the area's exports, which formerly went overland, now are shipped through Angola and Mozambique.

Venezuela's president Romulo Betancourt is apparently ready to fight even the opposition within his own party to foreign investment within Venezuela. The government has given its go-ahead for the $13.5-million, 25,000-tpy aluminum reduction plant which Reynolds Metals Co. wants to build at San Felix, on the Orinoco.

The project is a mixed-capital venture with participation by Reynolds and the Venezuelan government. Strong resistance to foreign mining entry has been building, and, earlier in the month, the Ministry of Mines & Hydrocarbons cancelled about two-thirds of the existing manganese concessions in Venezuela for failure by the owners to comply with development strictures.

The AEC has acted to implement its program for small mine producers in the Uravan mineral belt of Colorado, Utah and Arizona. Contracts signed with Kerr-McGee Oil Industries and Climax Uranium Corp. provide for the purchase of prescribed poundages of U_3O_8 in ores controlled by the two firms and also provide for future purchase of pounds of U_3O_8 in ores from independent miners with which the mills do not necessarily have contracts into the 1966 period.

British Government plans for rail access from the Portuguese seaport of Lourenco Marques in Mozambique to Swaziland's Bomvu Ridge iron ore and coal deposits are being given impetus by an expected Anglo American Corporation contract with Japanese ironmasters to begin supply of iron ore by early 1964. The Yamata and the Fuji iron and steel companies have made preliminary agreements with Anglo American to purchase nearly 12-million tons of ore over a 10 year period. A final contract awaits the negotiation of government and private financing of the proposed railway, and the fixing of a satisfactory rate for ore transport.

Lane Mountain Silica Co.'s new $500,000, 400-tpd silica processing mill at Valley, Wash., will begin production in January.

Construction of a tungsten ore mill will commence shortly at the Silver Hill property near Spokane. Robert N. Robey is mining engineer in charge of the 150-tpd plant.

WASHINGTON IMPACT

Highlights

A PROGRAM FOR 1961—Last month's American Mining Congress annual policy resolutions set out the maximum goals domestic mining industry leaders hope to persuade the new administration to aim for. As usual, they go considerably beyond party platform or politician's campaign pledges (see story this page and E&MJ—October '60, P.28.)

Once again, AMC called for a national minerals policy which would include increased import protection, stiffer anti-dumping regulations, and maintenance of government stockpiling with tightly controlled rules for surplus disposal.

The industry congress urged "reactivation" of federal loans for mine exploration and development, an Atomic Energy Commission policy for government uranium procurement after 1966, a modified return to the monetary gold standard, and price hikes plus removals of restrictions on gold and silver. Other recommendations included greater depletion allowances and other tax benefits, tighter labor controls, a lessening of restrictions on use of public lands for mining.

PRE-GATT TRADE DECISIONS—U.S. trade policy officials are poring over tomes of Tariff Commission and Committe for Reciprocity Information hearings and recommendations that will finally determine the exact imports on which the U.S. will offer tariff concessions early next year at international trade agreement bargaining sessions under the General Agreement on Tariffs and Trade (GATT) at Geneva.

The final "offer lists" are not made public until the bargaining actually begins. But the unofficial word making the rounds in Washington is that the final U.S. offer lists will be less inclusive than the tentative lists published last summer. One agency staffer predicts as many as half the items will be removed from the lists on grounds present duties currently are at or below the so-called "peril-point" of threatened injury to domestic producers.

A number of metal-mineral items, including those chemically processed, and still more synthetic chemicals are among those on which little or no tariff reduction may be bargained, industry representantives in Washington report they have been told privately by U.S. officials.

IRON ORE TARIFFS—Steel industry witnesses presented a strong front against proposed protective tariffs on iron ore before the Tariff Commission last month. Leading producer and union spokesmen challenged on both legal and economic grounds a move by domestic iron mines to win Tariff Commission support for removing imported ore from the duty-free list.

The Commission hearings, ordered by the Senate Finance Committee, took up the issue under the "escape clause" provisions of the trade laws, which steel industry witnesses claimed do not apply to an item on the free list, but are limited to items on which the U.S. has previously granted tariff concessions.

Further, the steel spokesmen argued, increased imports (35.6-million tons in 1959) and decreased domestic production (1202.6-million tons last year), has been caused by depleted high-grade domestic reserves and improved industry technology. Profits, wages, and employment are still increasing in the domestic industry, claim steelmen, and domestic production is not threatened.

CUBA OUT OF BOUNDS—Last month's Administration decision to ban most U.S. exports to Cuba, including particularly metals and manufactures, machinery, equipment, chemicals, and spare parts, is part of the new U.S. policy of regarding Castro as a declared enemy in the Communist camp. Castro has cut to the bone his U.S. purchases, but had continued buying desperately needed items in those categories.

For example, for the first six months of 1960 compared to the same period last year, Cuban purchases of all U.S. export items nosedived from $208-million to $142-million but imports of U.S. iron and steel mill products dropped only marginally from $6.9-million to 6.4-million, and buys of U.S. railway equipment soared from $0.5- to $4.5-million.

U.S. officials are divided over how quickly the U.S. export controls will worsen Castro's mounting economic problems.

Democrats Outline Mineral Proposals

A new Democratic party policy report on natural resources—"Resources for the People"—lays out in broad terms what the Democratic advisory council proposes in the way of Government mining and minerals legislation and regulation next year.

It promises a revival of stockpiling, skirts the issue of import protection, threatens a "review" of tax depletion allowances.

Like Republican party statements, the Democratic document puts heavy emphasis on new research and development programs.

The report is a blueprint of what Democratic party leaders are likely to urge as Federal programs in the industry next year, regardless of whether or not they win the election.

The advisory council natural resources committee which issued the report was headed by former Interior Assistant Secretary C. Girard Davidson of Portland, Ore. Its drafters included:

Former Interior Secretary Oscar Chapman, former Interior Department official William A. Brophy, and the Democratic governors of Alaska, California, Colorado, Connecticut, Kansas, and Wisconsin.

The report includes proposals on water, fish and wildlife, pollution control, outdoor recreation, lands and soils, forests, and energy—in addition a section on minerals and mining.

The minerals and mining section declares that "mineral self-sufficiency has not been achieved" in the U.S., and calls for "re-establishment of economic stability in the mining industry and the achievement of a reasonable level of mineral self-sufficiency."

Specifically, the report recommends:

"Resources in short supply must be imported and stockpiled.

"Intensive research in new methods of discovering and appraising mineral deposits, as recommended by the National Science Advisory Committee on mineral research, should be placed under way immediately. Maximum effort on such a program should locate ore deposits which can be economically mined with modern technology and labor standards in present world economic competition.

"The extent of our oil, gas, and mineral resources should be ascertained by an expanded program in topographic surveying and geologic mapping. An inventory of world resources also should be made in a joint and cooperative study with other free nations.

"Leadership in research in extraction and utilization of oil and minerals and their by-products for energy, industry, and agriculture should be undertaken by the Federal Government. Special attention should be given to secondary recovery of oil.

"National pilot programs should be expanded to convert oil shale, western

coals, lignites, and other fossil fuels, and radio-active minerals into more easily used forms of energy.

"Federal mine safety regulations should be vigorously enforced and cooperative efforts should be made to insure greater uniformity of mine safety inspection by state governments.

"Arbitrary discrimination and unreasonable restrictions by the U.S. government against the domestic production, ownership, and sale of metals should be terminated. (An apparent reference to gold and silver.)

"The depletion allowance system for income taxes should be thoroughly reviewed. Reasonable adjustment should be made so that mineral as well as oil and gas producers will receive fair and equitable treatment."

Included among the "basic changes" the Democratic report promises are:

A council of resources and conservation advisors under the President's executive office to "program long-range development; a national investment fund to finance Government and private resources development projects; and a "comprehensive" research and development program, including topographic and geologic mapping.

The report also calls for "carefully controlled" leasing of public lands to private mineral developers, and the "prevention" of monopolies.

In its section of criticisms of the Republican record, the report cites only one specific instance involving mining—the issuance of "unwarranted mining claims such as that of the Al Sarena Co. in national forests."

Depletion Will Survive

Regardless of who wins the White House, the next Congress is not going to eliminate depletion allowances on minerals.

So said Rep. Hale Boggs (D., La.) a key member of the House Ways and Means Committee, which has the first say-so in legislating any change in depletion allowances.

Boggs told the American Mining Congress that the political fuss about eliminating depletion is "just so much conversation." Boggs said, opponents have been trying to change the law "for the last 28 years, and we haven't even let them talk about it on the floor."

Nixon, of course has come out flatly for a retention of the depletion allowance—and has hit hard at the necessity for giving similar incentives (such as tax reform) so that industry will be encouraged to expand and thus give the country its necessary economic growth.

Kennedy, on the other hand, has fuzzied his stand on depletion—but has leaned clearly to the side of a lessening of present allowances.

Undersecretary of Interior Elmer F. Bennett charged that Kennedy has come out in favor of "plugging loopholes in depletion allowances," opposed import controls on foreign raw materials, including lead and zinc, and endorsed the Paley Report.

Labor This Month

AUTOMATION BREAKTHROUGH: In two key industries, giant steps are being taken to remove the sting from automation. These are the most significant gains so far in the growing battle between the workers and the machine. Employer-union teams in the railroad and West Coast longshore industries have come up with plans to at least forestall an all-out war over labor-saving devices and jobs. While they may not be the final answer, the solutions may provide clues for solution of automation troubles facing the steel, auto, electrical, mining and other industries. They bear close examination:

In the all-important contest over work rules, the carriers and five operating brotherhoods have handed their dispute to a tripartite Presidential Commission with orders to come up with a solution by the end of 1962. (Work rules were at the center of last year's 116-day steel strike.) The Commission's orders: Find a way for the carriers to eliminate outmoded jobs and yet protect the workers rights. The Commission's finding won't be binding on the parties but they're expected to carry considerable weight; not only to the carriers and rail unions but as an influence on others facing the effect of automation.

On the Pacific Coast docks, maritime employers and leaders of the International Longshoremen's and Warehousemen's Unions have a $31-million automation pact. The employers, to have a free hand in using labor-saving equipment on the docks, will set up an annual $5-million fund to help alleviate the loss in jobs and income to members of the dock union. The employers calculate, even with the payments into the automation fund, they'll save money by trimming the size of work crews, use of new cargo hauling equipment and elimination of restrictive work rules that have developed on the docks over the years. The price of the agreement, which covers some 12,000 longshoremen, indicates the gains to come from automation, particularly in an industry with high manpower costs.

LANDRUM-GRIFFIN COMES OF AGE: The first year's report on the workings of the 1959 Labor Reform Law indicates it is doing the job it set out to do—protect the democratic rights of union members. Labor Secretary James P. Mitchell says the new law is "advancing" collective bargaining, safeguarding union funds and preventing "under-the-table dealings" between labor and management. While few major violations have been uncovered during the first year, the report shows union members have "taken a more active interest in their union affairs" and have filed many complaints on election procedures, union bureaucracy and the like.

Here are some specific details:

In all, 52,278 unions filed reports; of these 269 were national or international unions.

A breakdown of union finances in the reports shows three-fourths of the unions charge less than $5 a month dues; 12% charge fees for transferring from one union local to another.

Unions reported total of 592 union trusteeships; 285 trusteeships were terminated during the year while 72 new trusteeships were added.

After one year's experience, no significant changes in L-G are proposed by the Labor Department. However, some amendments may be offered in the next Congress to strengthen procedural and enforcement rules. For instance, the Department wants to make it illegal to interfere with a Government agent in performing his L-G duties; also a request may be made to allow the Government to act for an individual who has undergone reprisals for making complaints against his union.

WAGE SETTLEMENTS HOLD UP: Whatever the trend of business in the last quarter of 1960, labor-management negotiations are holding level, with wage increases averaging about 9c an hour. This is even a slight gain over early 1960. Mine-Mill & Smelter Workers, in a new agreement with American Smelting & Refining Co. for 6,000 workers in nine states came to terms on a 7c to 9c increase while extending their mid-1961 contract another year. At the same time, pension and vacation benefits were increased.

MARKETS

Copper Producers, Smelters at 30c; Gold Erupts; Aluminum Mill Planned

THE E&MJ domestic copper average dropped 2¢ in October and, because of its heavy weight, the E&MJ metal price index slumped from 126.0% of the 1947-49 average in September to 122.2% in October, the lowest since August 1959. In October 1959 the figure was 126.1%. Tin was the only other metal price to move during the month, gaining slightly more than 1¢ over the period. With copper prices down further, the November index is expected to fall.

Copper activity headlined October's nonferrous metal news, but gold, buzzing briefly, probably gained more international attention.

The London-N.Y. copper price spread having reached 5¢ a lb, U.S. custom smelters had dropped 2¢ from 33¢ to 31¢ a lb at press time last month. The 2¢ spread between domestic producers (33¢) and smelters lasted from Oct. 3 until Oct. 11 at which time Kennecott Copper Corp. startled the world by cutting its domestic price for copper produced in the U.S. to 30¢ a lb delivered, effective Oct. 12. The price cut was a full cent more than expected, undercutting smelters by that amount.

Phelps Dodge Corp. followed down effective the same day. At the same time, the company announced that it had not returned to 100% of capacity after its strike settlement early in the year—but to 94%. The company said it would cut back to 90%. The Anaconda Co., already plagued by a walkout at its Chuquicamata mine in Chile, followed also effective Oct. 12.

Smelters at 31¢ had no choice but to cut 1¢ to become competitive. They did so as of Oct. 13 leaving all U.S. sellers but dealers at 30¢ a lb delivered. The price continued through the month and was responsible for the 2¢ decline in the domestic average to 30.598¢.

London continued to move off after U.S. price cuts and hit £217¾ prompt bid on Oct. 24, but recovered slightly and gained an appearance of stability at about £220(27½¢) as the month ended. Tariff, freight and insurance added approximately equates the imported price to the 30¢ U.S. level.

The new U.S. price does not appear to have excited buyers, but observers blame this on the state of the U.S. economy rather than the price situation. Copper sellers, interested in price stability as well as profits, are expected to make all efforts to hold the current price. Cutbacks, a stable LME and improved domestic buying may make this possible.

The weakness in copper brought several cutback announcements during October. The two big copper firms in Northern Rhodesia, Rhodesian Selection Trust and Anglo-American, each cut back 10%. RST said that it would curtail at the rate of 22,000 tpy. Anglo-American cut about 3,000 tpm, but reserved the decision to do so by direct output cutbacks or by stockpiling. In the eyes of many, the latter choice would be of little help. Rhodesia produced 593,000 tons of copper in 1959.

Katanga, which kept copper moving despite rebellion and counter rebellion in the Congo, will also cut back 10% (2,500 tpm). The company expects to produce 308,000 tons in 1960, only 3,000 less than in 1959.

Noranda in Canada has maintained a 1% a month curtailment and is running slightly ahead of its 10% goal for 1960. Phelps Dodge's intention is mentioned above.

The Anaconda strike in Chile is a month old. Mid-October rumors of a settlement turned out false. Word from Chile at press time reported a collapse in negotiations. Chuqui has been producing 21-22,000 tpm in 1960.

Domestic sales reported to E&MJ during the month were down in October, but foreign sales were only a shade under September's record.

Gold spurted on the London open market late in the month reaching $40.60 an oz on Oct. 20. It closed the month at about $36.125, about $1 over the U.S. Treasury buying price of $35.

A dozen reasons for the surge—the first since 1954—were ventured, but the major cause appeared to be pure speculation based on the belief that the U.S. would devaluate its dollar. The deficit in the U.S. balance of payments, led by substantial U.S. foreign investment, which has resulted in a steady flow of gold from here has stimulated this belief. Now, forecast of a Democratic presidential victory and possible inflationary action has provided another spark. Threat of a U.S. Treasury release of gold to European markets and the resultant glut has quieted the market, but gold will probably maintain its premium abroad until after the election here.

Aluminum production of 162,882 tons in September was 10,000 tons under August and 80.3% of capacity. September 1959 was 89%. Stocks of primary metal rose sharply again and at the end of July were 203,626 tons—a record.

Kaiser Aluminum cut out the second of its nine potlines at its Chalmette, La. plant early in the month. Each line there produces 27,000 tpy. Kaiser is now operating at 70% of capacity.

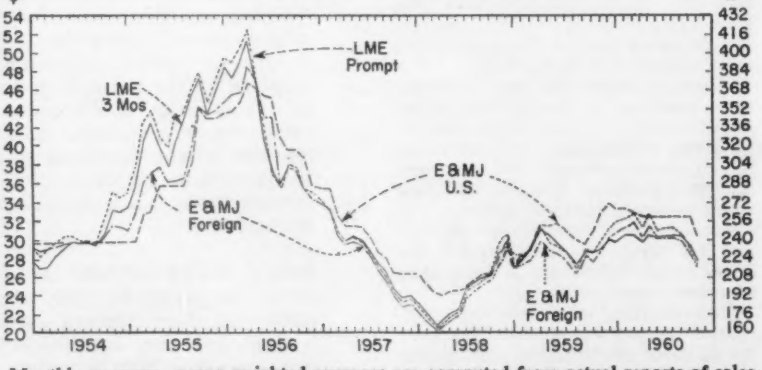
Aluminium Ltd., Bridgeport Brass, Cerro de Pasco and Scovill Manufacturing have joined together and will build a 100,000 tpy hot-rolling mill in the northeast U.S. All are fabricators of sheet aluminum. Hot-mill capacity, necessary for sheet output, is largely controlled here by the big integrated producers. As it stands all capacity will go to the owners. The project will cost $30-million.

With the action, Aluminium Ltd., who will operate the project, gains its first U.S. producing capacity. Participants will benefit from remelt facilities at the new plant which will enable customers to return scrap, a common practice among U.S. producers. Competition for sheet markets should intensify.

Lead and zinc sales reported to E&MJ in October were expected to about equal September. Both commodities, as was the case the previous month, picked up in the second half of the period. The zinc price of 13¢ East St. Louis was firm backed by industry strikes. Confidence in the 12¢ lead price was boosted by strong end-of-month average buying. Five Eagle Picher zinc mines in Illinois and Wisconsin were struck, but smelter stocks were judged more than ample for months ahead.

The Tariff Commission this month recommended continuance of lead and zinc quotas.

Copper Prices 1954-1960



Monthly averages. E&MJ weighted averages are computed from actual reports of sales to E&MJ—normally 140,000 to 17,000 tons per month. LME prices are the average of the mean of the bid and asked; they refer to long tons. The two scales are equal at an exchange rate of $2.80 per £. £320 is 40¢ a lb, etc. Data through Oct. 1960.

Average Prices October (E&MJ Quotations)

Cents per lb unless otherwise indicated:	
Copper:	
Electro, domestic refinery	30.598
Electrolytic, exports refinery	27.111
Electrolytic, c.i.f. Cont'l ports	28.056
Lead:	
Common, New York	12.000
Common, St. Louis	11.800
Silver:	
Silver, New York, per oz	91.375
Silver, London, pence per oz	79.488d
Zinc:	
Prime, Western, East St. Louis	13.000
Prime, Western, delivered (g)	13.500
Tin:	
New York Straits	103.319
Gold, per oz, U.S. price	$35.000
Sterling, Exchange	281.158
Quicksilver, per flask	$209.000
Antimony, (E&MJ) (d)	32.590
Antimony, bulk, Laredo	29.000
Antimony, in cases, Laredo	29.500
Antimony for. 99%	23.875
Palladium, troy oz	$24.000
Platinum, refined, per oz	82.000
Cadmium (a)	150.000
Cadmium (b)	160.000
Al, 99½% unalloyed ingot	26.000
export, ingot	23.250
Magnesium, ingot	35.250
Nickel, (f)	74.000
Bismuth	$2.250
Cobalt	$1.500

Domestic quotations, unless otherwise stated are in cents per lb. Sterling exchange checks, in cents. Quicksilver per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.
(h) 2c duty extra.

Free Gold Market

The volume of international gold dealings rose 55% above the September level as heavy buying pressure pushed bar and coin prices up in almost every center. The yellow metal price hit a high of $41.50 per ounce in London where volume of transaction surpassed all records since the reopening of the market in 1954. Gold futures were also highly active as dealings averaged three million dollars daily. Carrying charges varied from 4% p.a. in Zurich to 4¾% p.a. in London. U.S. gold stock declined further to a low of 18.473 billion. Private gold hoards throughout the world increased about 3% to a total of 13.6 billion. Pick's World Currency Report quotes on "free gold" per fine oz. as follows:

	Coins		Bars (12.5 kg)	
	Sept. 30	Oct. 31	Sept. 30	Oct. 31
New York transit	.....	.....	$35.08½	$36.00
Manila	$40.50	$41.50	36.10	37.50
Hong Kong	47.25	48.50	39.30	40.65
Bombay	53.00	54.30	52.50	51.25
Beirut	39.70	41.00	35.35	36.28
Paris	40.10	40.60	35.80	36.90
Buenos Aires	39.70	41.80	35.88	37.80

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Custom Smelter Copper

Based on flat price and E&MJ average price sales in U.S. for month of October reported by American Smelting & Refining Co. electrolytic copper in standard shapes, adjusted to nearest ⅛c; ¼c deducted for selling common.

Delivered consumer's plant	30.500 lb
F. o. b. refinery	30.100 lb

Major Metals

U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

Oct. 1960	Electrolytic Copper (a) Domestic	(b) Export	Europe c.i.f. (c)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Ingot 99% U. S. Dest.	Straits Tin New York
3	32.200	27.825	28.770	12.000	11.800	13.500	13.000	26.000	102.875
4	32.475	27.425	28.370	12.000	11.800	13.500	13.000	26.000	102.875
5	32.475	27.550	28.495	12.000	11.800	13.500	13.000	26.000	103.125
6	32.575	27.475	28.420	12.000	11.800	13.500	13.000	26.000	103.375
7	32.425	27.450	28.395	12.000	11.800	13.500	13.000	26.000	103.500
10	32.425	27.350	28.495	12.000	11.800	13.500	13.000	26.000	103.750
11	32.575	27.475	28.420	12.000	11.800	13.500	13.000	26.000	103.750
12	Holiday	27.475	28.420	Holiday					
13	29.600	27.175	28.120	12.000	11.800	13.500	13.000	26.000	103.750
14	29.600	27.025	27.970	12.000	11.800	13.500	13.000	26.000	103.500
17	29.600	27.025	27.970	12.000	11.800	13.500	13.000	26.000	103.750
18	29.600	27.050	27.995	12.000	11.800	13.500	13.000	26.000	103.125
19	29.600	26.900	27.845	12.000	11.800	13.500	13.000	26.000	103.125
20	29.600	26.875	27.820	12.000	11.800	13.500	13.000	26.000	103.375
21	29.600	26.875	27.820	12.000	11.800	13.500	13.000	26.000	103.250
24	29.600	26.625	27.570	12.000	11.800	13.500	13.000	26.000	103.000
25	29.600	26.650	27.595	12.000	11.800	13.500	13.000	26.000	103.000
26	29.600	26.725	27.670	12.000	11.800	13.500	13.000	26.000	103.250
27	29.600	26.825	27.770	12.000	11.800	13.500	13.000	26.000	103.250
28	29.600	26.725	27.670	12.000	11.800	13.500	13.000	26.000	103.250
31	29.600	26.625	27.570	12.000	11.800	13.500	13.000	26.000	103.500
AVERAGES FOR MONTH									
Oct.	30.598	27.111	28.056	12.000	11.800	13.500	13.000	26.000	103.319
AVERAGES FOR WEEK									
Oct.									
5	32.470	27.865	28.810	12.000	11.800	13.500	13.000	26.000	102.775
12	32.500	27.485	28.430	12.000	11.800	13.500	13.000	26.000	103.594
19	29.600	27.035	27.980	12.000	11.800	13.500	13.000	26.000	103.450
26	29.600	26.750	27.695	12.000	11.800	13.500	13.000	26.000	103.175
CALENDAR WEEK AVERAGES									
Oct.									
7	32.430	27.545	28.490	12.000	11.800	13.500	13.000	26.000	103.150
14	31.050	27.340	28.285	12.000	11.800	13.500	13.000	26.000	103.688
21	29.600	26.945	27.890	12.000	11.800	13.500	13.000	26.000	103.325
28	29.600	26.710	27.655	12.000	11.800	13.500	13.000	26.000	103.150

THE above quotations for mapor nonferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered U.S. basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance, Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West and West effective Apr. 1, 1960, commanded a premium of 1.50c per pound over the current market for Prime Western; Special High Grade 1.75c effective Apr. 1, 1960.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U. S. lead is corroding grade).

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harmon in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Oct. 1960	Silver (c) New York	Silver London	Sterling Exchange	Gold (d) London
3	91.375	79.250d.	281.1200	250s. 6¼d.
4	91.375	79.500d.	281.0200	250s. 6¾d.
5	91.375	79.500d.	281.0000	250s. 6¾d.
6	91.375	79.500d.	280.9680	250s. 9d.
7	91.375	79.500d.	281.0860	250s. 8¼d.
10	91.375	79.500d.	280.9920	250s. 8½d.
11	91.375	79.500d.	280.8900	250s. 9¾d.
12	Holiday	79.500d.	Holiday	250s. 10¼d.
13	91.375	79.500d.	281.0080	250s. 10½d.
14	91.375	79.500d.	280.9560	250s. 10d.
17	91.375	79.500d.	280.9680	250s. 10¼d.
18	91.375	79.500d.	281.1000	251s. 0d.
19	91.375	79.500d.	281.1800	251s. 8d.
20	91.375	79.500d.	281.3660	260s. 0d.
21	91.375	79.500d.	281.3780	260s. 0d.
24	91.375	79.500d.	281.3300	268s. 0d.
25	91.375	79.500d.	281.3480	270s. 0d.
26	91.375	79.500d.	281.2160	260s. 0d.
27	91.375	79.500d.	281.2400	254s. 0d.
28	91.375	79.500d.	281.4050	257s. 0d.
31	91.375	79.500d.	281.5980	256s. 0d.
AVERAGES FOR MONTH				
Oct	91.375	79.488d.	281.158	—
AVERAGES FOR WEEK				
Oct.				
5	91.375	—	281.034	—
12	91.375	—	280.984	—
19	91.375	—	281.042	—
26	91.375	—	281.328	—

Calendar Week Averages: New York Silver: Oct. 7, 91.375; Oct. 14, 91.375; Oct. 21, 91.375; Oct. 28, 91.375.

MARKETS (*Continued*)

London Metal Exchange Quotations

Oct. 1960	Copper Cash Bid	Copper Cash Asked	Copper 3 Mon. Bid	Copper 3 Mon. Asked	Lead Current Month Bid	Lead Current Month Asked	Lead 3 Mon. Bid	Lead 3 Mon. Asked	Zinc Current Month Bid	Zinc Current Month Asked	Zinc 3 Mon. Bid	Zinc 3 Mon. Asked	Tin Cash Bid	Tin Cash Asked	Tin 3 Mon. Bid	Tin 3 Mon. Asked
3	225	225¼	226¾	227	68¼	68⅛	69¾	70	86¼	86⅛	86¼		802⅛	803	799½	800
4	226⅛	226¾	228⅛	228¾	68⅛	68⅜	69¾	70	87	87⅛	87	87⅛	801½	802	798	798½
5	225¾	226	227¾	228	67¼	67¾	68¾	69	87¼	87½	86¾	87	803½	804	799½	800
6	223¾	224	225½	225¾	66¾	67	68⅝	68¾	87¼	87⅜	87⅛	87¼	804	805	800	801
7	224⅜	225	226½	226¾	66⅛	66¼	68	68⅛	87⅜	87½	87¼	87½	806½	807½	800½	801½
10	225¼	225½	227	227¼	66⅛	66⅜	68¼	68⅜	87⅜	87½	87¼	87½	807½	808½	801	801½
11	226	226¼	227¾	228	66¼	66⅜	68¼	68¼	88¾	88⅞	88	88½	810½	811	801	801½
12	223¼	223½	224¾	225	66¾	67	68¼	68½	89	89½	87¾	88	812	813	801	801½
13	222¾	223	224¼	224¼	66¼	66¼	68	68¼	88¾	89	87¼	87½	808	809	798	799
14	221¾	222	223½	223½	66⅜	66½	68¼	68⅜	87¾	87⅞	86½	86¾	810	810½	797	798
17	222¾	223	224½	224½	67	67¼	68½	68¾	87½	87⅝	86⅜	86½	810	811	798½	799
18	222	222¼	223¾	224	67	67½	68½	68⅝	87¼	87½	86	86½	808	809	797½	798
19	219¾	220	221½	222	66¼	66¾	68	68¼	86½	86⅝	85⅜	85⅝	804	804½	794½	795
20	220½	220¾	222½	223	66½	67	68⅛	68⅛	87¼	87½	85¾	86¼	808	808½	799½	800
21	221	221¼	223	223½	66¾	67	68⅜	68½	88¼	88½	86¼	86½	804	805	799	799½
24	217¾	218	220	220¼	67	67¼	68½	68⅝	88	88⅛	85⅞	86⅛	799	800	794½	795
25	220	220¼	221¾	222	67½	68	68¾	69	88	88¼	86⅛	86¾	800	801	795½	796
26	218¼	218½	220½	220¾	68¼	68½	69	69¼	88½	88⅝	86⅜	86½	798	798½	795	796
27	219¼	219½	221¼	221½	68⅞	69	69⅜	69½	88¾	89	86⅜	86⅝	795	796	794	795
28	219	219¼	220¾	221	67⅞	68	68¾	68⅞	88½	88¾	86	86¼	795½	796	794½	795
31	219¼	219½	221¾	221½	67¾	68¼	68¾	69¼	88½	89	85½	85¾	796	796½	795½	796
Av'g's	£222.232		£224.071		£67.250		£68.679		£87.911		£86.622		£804.357		£798.107	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.0%, zinc 98% and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty extra.

MISCELLANEOUS METALS

Oct. 31, 1960

Aluminum ingot, 99.9% lb		28c
Antimony, spot, lb, less than carload, in cases		32.59c
In bulk, carload lots, f.o.b. Laredo		29.00c
Imported, 10 ton min. (p), 99% Duty not paid	23¾ —	24c
Bismuth, ton lots, lb		$2.25
Cadmium, ton lots delivered, lb		$1.50
small lots		$1.60
Calcium, lb, ton lots, 98%, cast		$2.05
Chromium, 97% grade, lb, contract delivered		$1.29
Cobalt, 97 to 99%, per lb effective 3-1-60		$1.50
Germanium, per gram, 10,000 gram lots	(d)28.15c—(c)(d)	29.95c
Indium, troy oz	$1.35 —	$2.25
Lithium, lb, 98%	$9.00 —	$11.00
Nickel, cathodes, lb (a)		74c
Other sales, regular sellers		74c
Sales by dealers, etc		74c
Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr. 16		35¼
Palladium, troy oz	$24 —	$26
Platinum, troy oz	$81 —	$85
Quicksilver, flask of 76 lb, 25 flasks or more	$209 —	$212
Selenium, 99 plus %, lb—(Feb. 19, 1958)	$6.50 —	$7
Silicon, minimum 98%, carloads, lb		19c
Semi Conductor grade, lb		$360
Tellurium, lb		$4.00
Thallium, 100 lb or more		$7.50
Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b)	$1.50 —	$1.60

(a) Effective Dec. 6, 1956; including U. S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium ore, imported, 10% BeO, (b) stu; spot	$31.75 —	$32.50
term contracts	$34 —	$34.50
Chrome ore per long ton, f.o.b. cars Atlantic ports, dry:		
44% Cr_2O_3 no ratio	(a)$19.75 —	$20.50
48% Cr_2O_3 3 to 1 ratio	$35¾ —	$38
Iron ore, Lake Superior, Lower Lake ports, lt		
Old Range bessemer		$11.70(e)
Mesabi bessemer		$11.60(e)
Mesabi non bessemer		$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton		$141.72

Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.

Molybdenum ore, 90%, per lb of Mo f.o.b. mines		$1.25
Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.18 —	$1.25
Tungsten ore, per stu of WO_3:		
Foreign 60%, c.i.f. U. S. ports, duty extra	$18.50 —	$19.00
U. S. scheelite, f.o.b. mill	$22 —	$24
Vanadium ore, per lb of contained V_2O_5 f.o.b. mines		31c
Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton		$80

(a) Nominal. (b) c.i.f. U. S. ports. (c) Effective 1958 shipping season.

METALLIC COMPOUNDS

Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks		4–5c
Cobalt oxide, 72½% to 73½%, per lb, effective Mar. 1, 1960	$1.15 —	$1.18
Copper sulphate, 100 lb. effective 10-12-60		$12.25
Germanium dioxide, gm		16¾c
Molybdic trioxide, technical, per lb of Mo	$1.46 —	$1.47
Imported, including 37c duty	$1.75 —	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr, (4-9% C)		28¾c
Ferromanganese, 74 to 76%, per lb shipping point		11c
Ferromolybdenum, 58 to 64% Mo. lb of Mo contained	$1.50 —	$1.82
Ferrosilicon, 50% per lb of Si f.o.b. shipping point (3-1957)		14.60c
Ferrotungsten, 72 to 82%, lb of W contained		$2.15
Ferrovanadium, per lb of V delivered	$3.20 —	$3.40
Silicomanganese, max., 1½% C, lb contracts		11.6c
Spiegeleisen, per lt, 19–21% grade effective Jan 22	$100.00 —	$102.50

NONMETALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:			
Crude No. 1	$1,400–$1,725	Paper stock	$120–$142
Crude No. 2	$750–$1,100	Waste	$75– $86
Spinning Fibers	$350– $565	Shorts	$22– $75
Shingle fibers	$180– $220		
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):			
Crude No. 1	$1,522	Spinning fibers	$220–$787
Asbestos, Vermont, f.o.b. Morrisville:			
Spinning fibers	$353– $408	Waste, stucco or plaster	$86
Shingle stock	$181– $218		
Paper stock	$120– $142	Refuse or shorts	$41– $75

Barytes, f.o.b. cars:		
Georgia, crude, per ton		$18
Missouri, 94%, $BaSO_4$, per st	$16 —	$18
Crude oil well grade, min. 4.3 sp gr, st (a)		$18
Imported, c.i.f. Gulf Ports, st	$16 —	$18
Bauxite, st, f.o.b. point of shipment:		
Domestic, crude, 50%, 8% Fe, 13% Si	(c)$12.25 —	$13.50
Imported metallurgical, per lt, f.o.b. Br. Guiana, 60% Al_2O_3, 6% SiO_2, 1.25% Fe, 1-1-60		$7.25
Feldspar, bulk ton; f.o.b. plants:		
Potash or soda feldspar, 200 mesh, ceramic grade	$17 —	$20.50
Glass feldspar, white, 20 mesh		$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 —	$41
60% effective CaF_2	$33 —	$36
Acid 97% concentrate, bulk, ton		$45.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 —	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington		$46

Mica—Domestic, f.o.b. mines, Punch 7c-12c per lb according to size and quality. Sheet clear 1½x2 in. 70c-$1.10; 2x2 in $1.10 to $1.60; 2x3 in, $1.60-$2.10; 3x3 in, $1.80-$2.30; 3x4 in, $2.00-$2.60; 3x5 in, $2.60-$3.00; 4x6 in, $2.75-$4.00; 6x8 in, $4.00-$8.00. Wet ground, very fine, $140-$155 per ton, Bulk sales, dry ground; $30-$55 per ton. Scrap $20-$30.

Ocher, Georgia, ton in sacks	$26.50 —	$32.00
Sulphur, Mexican, for use in Mexico, metric ton, f.o.b. mines, depending on location	$21 —	$23
For export f.o.b. vessel, depending on grade	$20.50 —	$22

Actual prices received by U. S. producers approximate the Mexican export prices.

Talc, f.o.b. works, ton:		
New York, purified	$18.00 —	$20.00
Vermont, extra fine		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

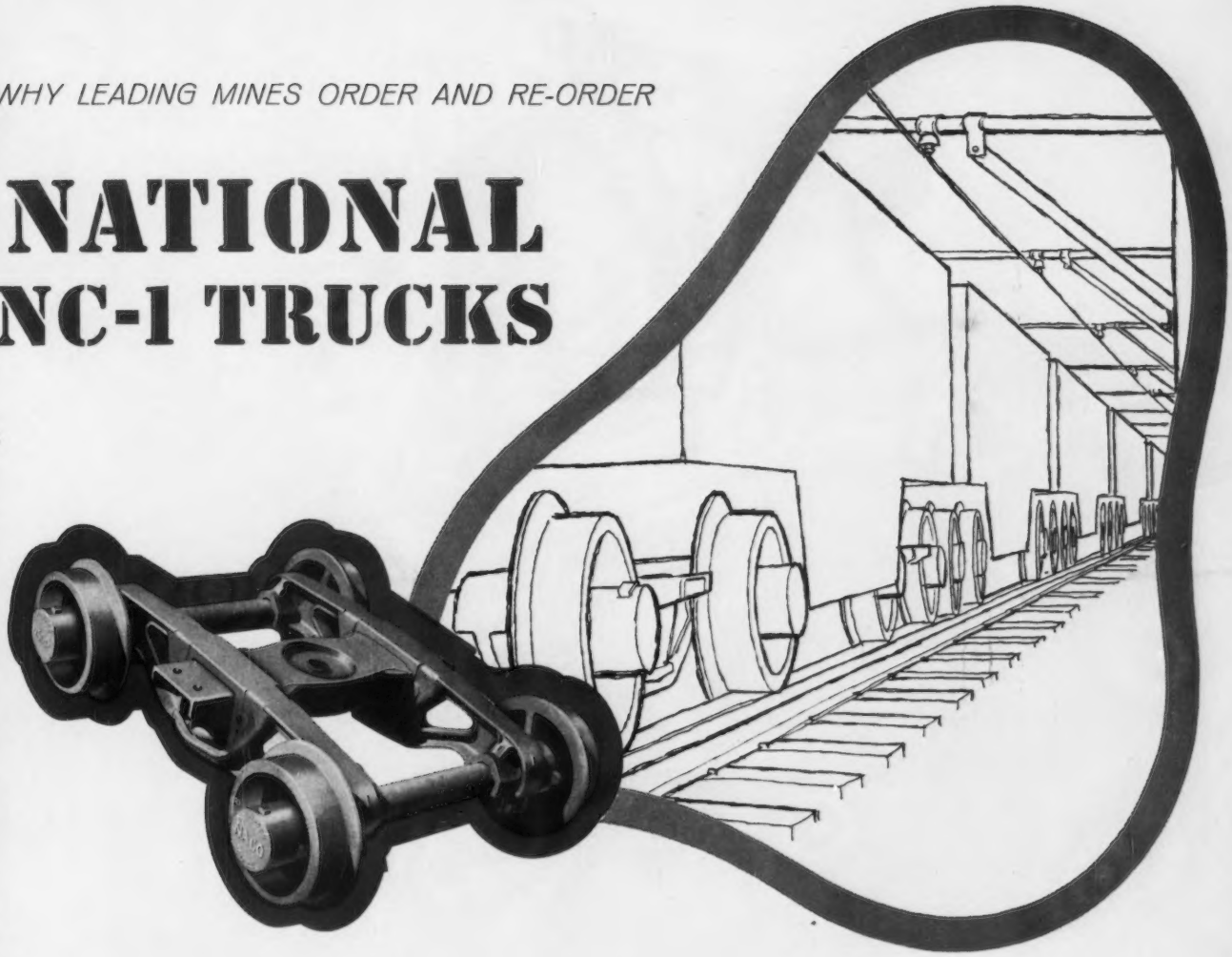
(a) Some restricted sales at $11.50, (b) Corrected. (c) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$80.00
Structural shapes, Pa., Ala., etc., 100 lb	$5.30 —	$5.50

WHY LEADING MINES ORDER AND RE-ORDER

NATIONAL NC-1 TRUCKS



The reasons for the decided swing to National NC-1 Trucks are fundamentally two: they provide safety to personnel and equipment... they make money for mine operators. There are lots of technical reasons, too. Let our representatives tell you all about them.

A-1792A

Mine Sales • Transportation Products Division

WILLISON AUTOMATIC COUPLERS
•
RUBBER CUSHIONING DEVICES
•
NACO STEEL WHEELS
•
NACO STEEL LINKS
& SWIVEL HITCHINGS

NATIONAL
MALLEABLE AND STEEL
CASTINGS COMPANY

Cleveland 6, Ohio

PEABODY COAL COMPANY
SUNNYHILL MINE
1650-B

The tail that wags the dog—

USS Tiger Brand Amerclad Cable

This 65-cubic-yard shovel scoops overburden at the rate of 1,500,000 cubic yards a month at the Sunnyhill Mine of the Peabody Coal Company. It operates on a 6,900-volt electrical system and has a 9,000 horsepower capacity including all motors.

Power is supplied through a USS Tiger Brand Amerclad Cable. The cable takes a lot of abuse in its long run under a roadway, through a creek and over jagged rocks. It is standard 8KV three-conductor Type SH-D cable. The insulation is tough, flexible Amerzone rubber. Each conductor is shielded for safe handling with a close serving of tinned copper wires securely bound in place and supplemented by heavy copper ground conductors. Such a shield provides the flexibility lacking in a full copper braid and avoids the break-up of the wires due to chafing at cross over points.

Ground wires, Neoprene fillers and a heavy, tough, reinforced jacket of oil resistant Amerprene complete the cable. And by providing positive clearing of the cable in case of a "short," this construction is tops in safety.

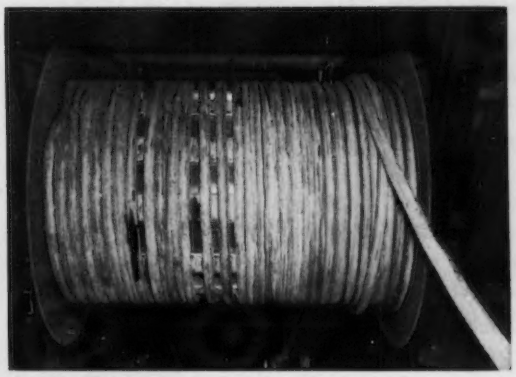
American Steel & Wire also makes Armorlokt cables, bore hole cables and a complete line of power distribution cables noted for their high quality. For complete information, write American Steel & Wire, Dept. 0449, 614 Superior Ave., N.W., Cleveland 13, Ohio, or contact our nearest distributor.

USS, Tiger Brand, Armorlokt, Amerclad, Amerprene and Amerzone are registered trademarks

USS Tiger Brand Electric Wire & Cable

A standard cable for every special job

- Asbestos Wire and Cable
- Mold-Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable



Greater flexibility of Amerclad permits constant reeling and unreeling.

Constant exposure to mud, acid mine water, abrasion and weather doesn't harm Amerclad Cable.

The tail that wags the dog. Tiger Brand Amerclad Cable (foreground) is the finest you can get for big shovel power supply.

American Steel & Wire
Division of
United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

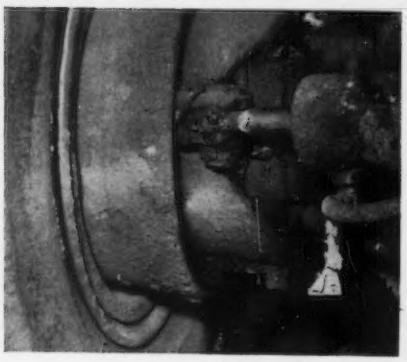
Hi-Torque brakes make underground hauling safer; hold 44 tons on 20% grades

This shuttle car is one of several KW-Dart vehicles in use at the White Pine Copper Company mine at White Pine, Michigan. The cars are equipped with B.F.Goodrich Hi-Torque brakes, designed for heavyweight off-the-road vehicles.

Each car weighs 44 tons fully loaded with copper ore. White Pine reports the ability of Hi-Torque brakes to handle such heavy loads safely is an outstanding advantage. With full loads, the vehicles hold on steep grades encountered in the mine, ranging up to 20 percent.

The cars are being used on a round-the-clock basis, 7 days a week, with brakes applied most of the time the vehicles are moving. Yet in several months of operation no maintenance or replacements have been required.

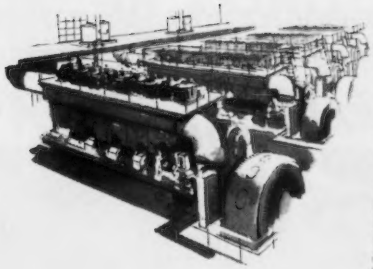
Investigate Hi-Torque brakes for your heavy duty vehicles...now available on several makes of equipment. For booklet write *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept. EM-11, Troy, Ohio.*



Closeup of Hi-Torque brakes on shuttle car wheel. The cars are used over hilly, rocky and muddy terrain.

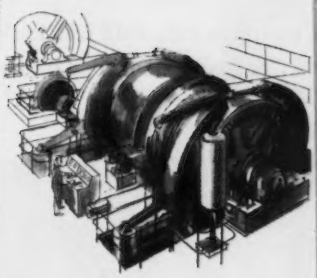
B.F.Goodrich Hi-Torque brakes

NORDBERG MINING MACHINERY



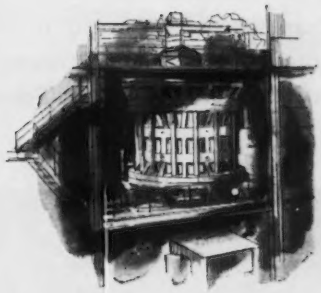
FOR POWER GENERATION

Nordberg engines are built in sizes from small 10 horsepower units to over 12,000 horsepower . . . and are available for Diesel, Duafuel® and Spark-Ignition Gas operation.



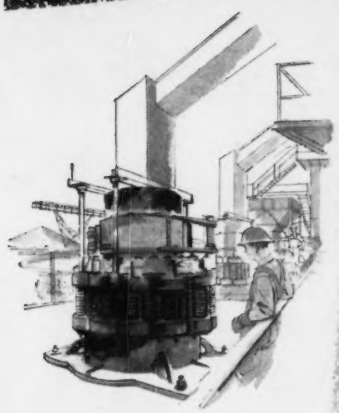
FOR HOISTING

Nordberg has an established reputation second to none, and can furnish both conventional and friction type mine hoists for men and material, to meet specific requirements.



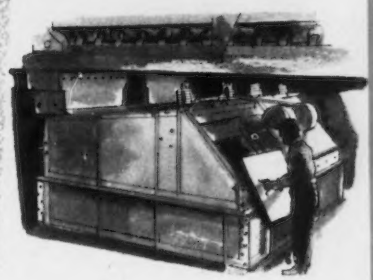
FOR PRIMARY CRUSHING

Symons® Primary Gyratory Crushers are built for big tonnage, heavy duty primary breaking in 30″, 42″, 48″, 54″, 60″, and 72″ feed opening sizes. Capacities to 3500 or more tons per hour.



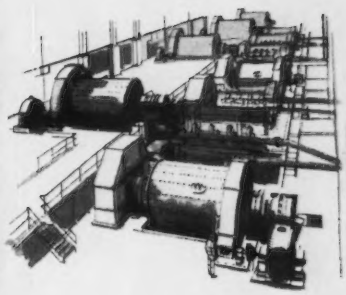
FOR REDUCTION CRUSHING

Symons Cone Crushers are built in both Standard and Short Head types, in sizes from 22″ to 7′ in diameter. Capacities from 6 to 900 or more tons per hour.



FOR SCREENING

From scalping to fine screening, there is a Symons Screen built to do a better job at low cost. Let Nordberg experience help you select the screen best suited to your needs.



FOR WET AND DRY GRINDING

Nordberg Grinding Mills include Rod, Ball, Pebble, Tube and Compartment types, in sizes from 6′ to 13′ in diameter and up to 50′ in length.

SYMONS . . . A registered Nordberg Trademark Known Throughout the World.

NORDBERG MANUFACTURING COMPANY

MILWAUKEE 1, WISCONSIN

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M460

ATLANTA • CLEVELAND • DALLAS • DULUTH • HOUSTON • KANSAS CITY • MINNEAPOLIS • NEW ORLEANS • NEW YORK • ST. LOUIS
SAN FRANCISCO • TAMPA • WASHINGTON • TORONTO • VANCOUVER • JOHANNESBURG • LONDON • MEXICO, D. F.

THIS IS MARION QUALITY

There's a special place reserved in Excavator Engineering Heaven for the men who designed this remarkable Marion propel brake. Note the location? Right out in the open where it's easy to service. Notice, too, the single hydraulic spring adjustment that rarely needs attention. To protect against rock slides, the entire assembly is enclosed in an easily removable metal cover. You can't see it here but a simple gear ratio multiplies the initial braking force into many thousands of pounds of holding force at the crawlers—where it counts. But, perhaps the most remarkable point of all is the basic simplicity of a *single* braking point. Routine maintenance becomes just that... a sort of ho-hum operation since all components are fabricated from special steels designed for extra-fast heat dissipation. And response? Let's put it this way. When the operator flips the convenient electric control switch up in the cab, this Marion will stop RIGHT NOW. Marion Quality in action? We think so. Marion Power Shovel Company, Marion, Ohio. A Division of Universal Marion Corporation.

MARION

MOLY ALLOYS MEAN LONGER LIFE WHERE YOU NEED IT MOST

In the mine, in the pit, in the quarry . . . the payoff is at the point of hardest wear. Specify long life molybdenum-containing alloys in your equipment and you immediately cut down the number of shutdowns for part replacement, and increase productivity without boosting capital investment.

You can satisfy just about every high wear rate application with one of the four grades developed by Climax . . .

For gouging abrasion plus impact, **use 12-2 alloy.**

For grinding abrasion, **use chrome-moly steels.**

For scratching abrasion and erosion, **use 15-3 alloy.**

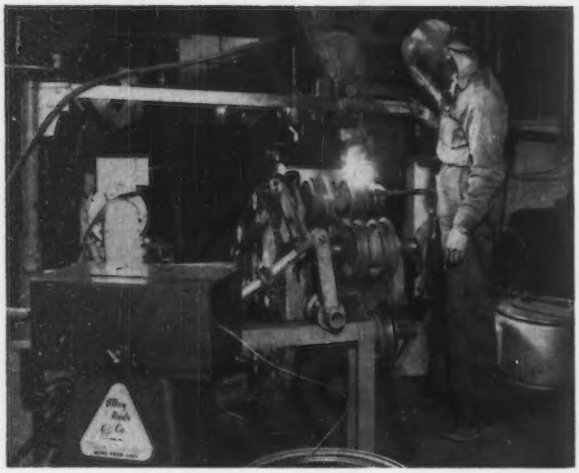
For general purpose abrasion resistance, **depend on 3-2-1 alloy.**

All four have been proved in years of actual mining use. Make sure your equipment benefits by these advanced materials.

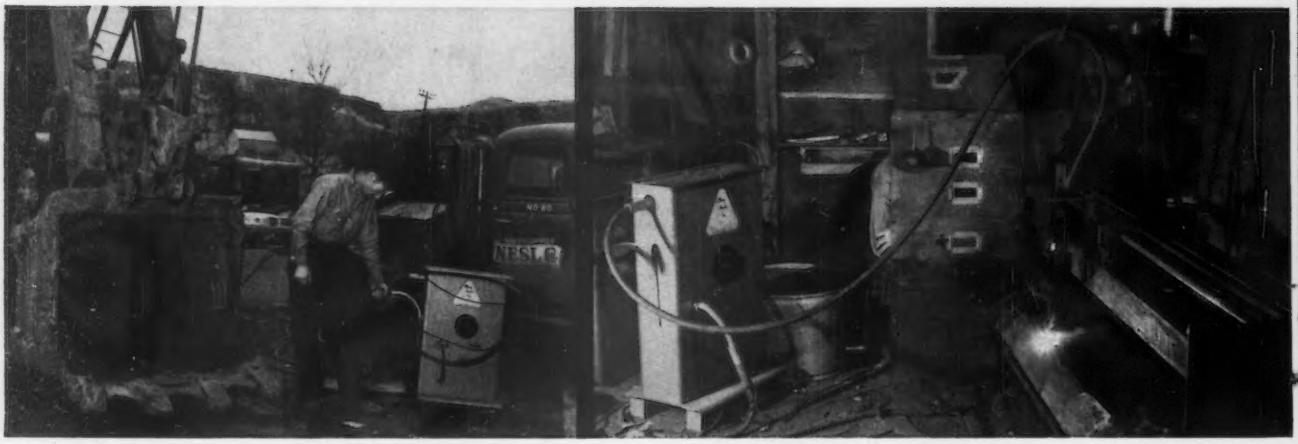
Complete details are in "The Role of Molybdenum In Abrasion Resistant Materials", available on letterhead request.
Climax Molybdenum Company,
1270 Ave. of Americas,
New York 20, N. Y.

CLIMAX MOLYBDENUM

CLIMAX MOLYBDENUM COMPANY
a division of AMERICAN METAL CLIMAX, INC.



Enterprising Raymond Steele, always alert to new time saving methods, constructed this six spindle roller rebuilder utilizing the Wear-O-Matic open arc hard surfacing process, greatly increasing the efficiency of his operation. Geared to the constant feed of Wear-O-Matic alloys from 100 pound Weld-Paks, this machine turns out roller after roller rebuilt and hard surfaced with long wearing deposits.



Equipment too large or cumbersome to be moved to the shop for rebuilding can be hard surfaced semi-automatically at the job site. The versatile Wear-O-Matic Wire Feed Unit and Weld-Pak is easily transported for field application of Wear-O-Matic wires.

By attaching the Wear-O-Matic welding nozzle to an automatic travel device, New Enterprise rebuilds crusher hammers automatically at a tremendous savings over manual applications. In addition, the weld deposit is smoother and more uniform.

New Enterprise Stone & Lime Co., Roaring Springs, Pennsylvania, operates seven plant locations in west-central Pennsylvania. This diversified, complex organization produces ready-mix concrete, pulverized rock, agricultural lime, black-top road material and pre-stressed concrete structures in addition to road and sewer construction projects and turnpike maintenance. Trucks, shovels, dozers, loaders and other movable equipment are maintained at the central maintenance shop in Roaring Springs under the guidance of Raymond Steele, Maintenance Supervisor.

Production Soars—Costs Go Down for Maintenance Shop Handling Seven Quarries

WEAR-O-MATIC PROCESS PROVIDES THE ECONOMY AND VERSATILITY NECESSARY FOR A VARIETY OF EQUIPMENT

Maintaining the equipment necessary for operating seven plant locations keeps even the well equipped, efficient shop of New Enterprise Stone & Lime Co. hustling for time saving, cost saving methods. The production per man hour possibilities of the Wear-O-Matic hard surfacing process led Mr. Raymond Steele, Maintenance Supervisor, to purchase one of the first Alloy Rods Company Wear-O-Matic Wire Feed Units. The results were so outstanding in time saving, diversified uses and superior, long-wearing deposits from Wear-O-Matic wires that New Enterprise now employs four Wear-O-Matic units in its program.

Says Mr. Steele . . . "With the Wear-O-Matic process, we put down 3 to 5 times more weld metal per hour than with stick electrodes. With no waste from left over stub ends, the semi-automatic wire costs us less per pound. Another item that saves valuable time . . . once you strike the arc with Wear-O-Matic, you don't stop until the job is finished. You get 100 pounds of continuous electrode in each Weld-Pak, ideal for our automatic set-ups. The deposits we get with Wear-O-Matic wires really hold up. We've had better results than with any other wire we've ever tried, and we have tried most of them."

Productive capacity, operating costs, deposit quality, shop versatility are important factors for efficient maintenance operations. The Wear-O-Matic hard surfacing process provides these advantages and at a cost within the range of any shop regardless of size. Find out now how the Wear-O-Matic process can increase the capacity of your maintenance shop.

Call your Alloy Rods Company distributor or representative for a Wear-O-Matic demonstration in your own shop. Or write to Alloy Rods Company, P. O. Box 1828, York 49, Pa., for more information.

ALLOY RODS COMPANY

YORK, PENNSYLVANIA

SALES OFFICES & WAREHOUSES; BOSTON, NEWARK, PHILADELPHIA, PITTSBURGH, BIRMINGHAM, CHICAGO, SAN FRANCISCO & EL SEGUNDO, CALIF.—DISTRIBUTORS IN ALL OTHER PRINCIPAL CITIES

TWENTY YEARS OF LEADERSHIP IN THE DEVELOPMENT OF QUALITY ALLOY ARC WELDING ELECTRODES

Reporting more news from . . :

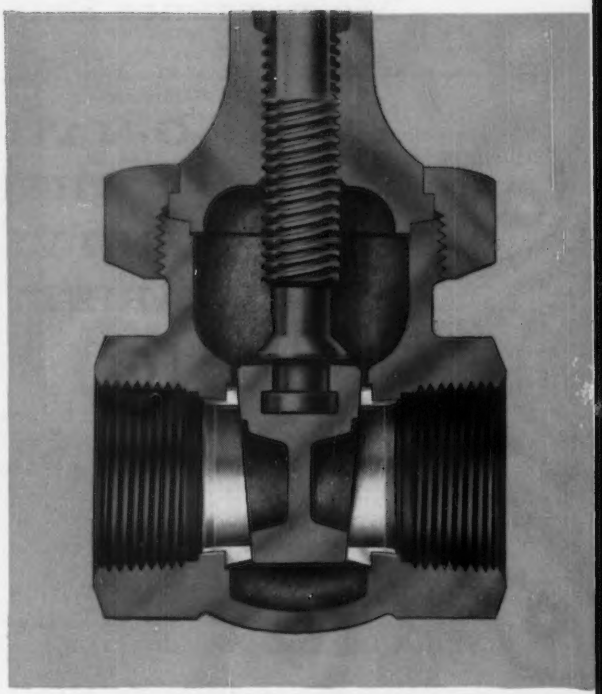
CRANE DIRECTION'70

. . . a fast-moving program of planned expansion, product development, and streamlined distribution to help our customers meet the competitive challenges of the Sixties.

Only from Crane—this rugged bronze valve in a full range of pressure classes and sizes

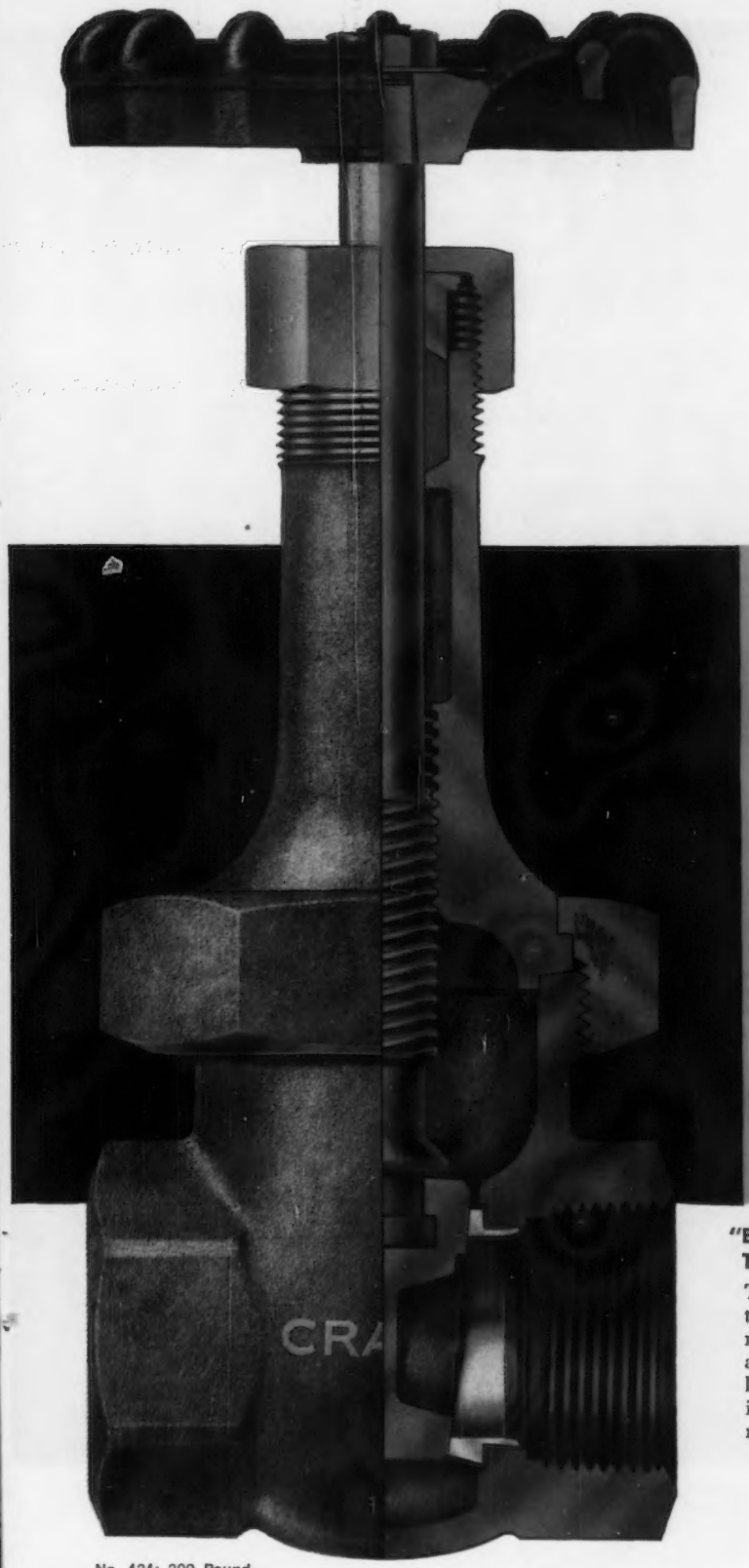
Use these on your toughest services! Here are valves with a built-in safety factor that far exceeds minimum standards. Modern, cylindrical body design—the same as used on high-pressure steel valves—gives you extra protection against body distortion that causes leaks. Crane Exelloy seat rings defy operating wear and damage from foreign matter... drastically reduce your valve maintenance costs. And you get this extra performance at no more cost than you pay for a valve built to only minimum standards.

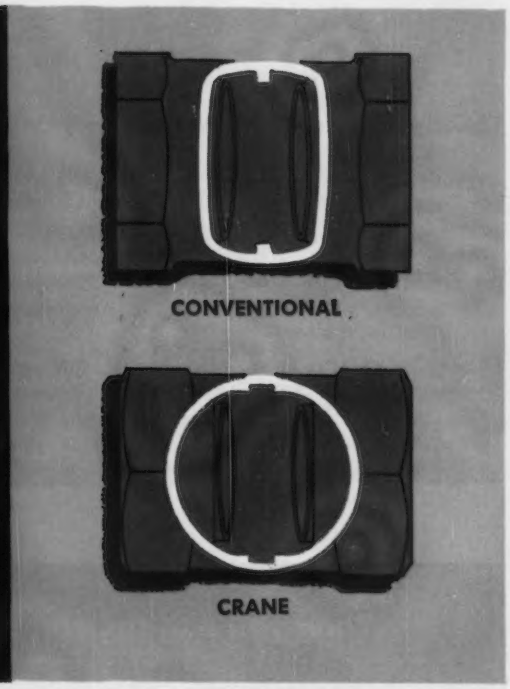
In addition to all these quality features, Crane gives you a far wider selection than any other comparable bronze valve line . . . a full range of sizes from ¼" to 3" . . . in both 200-pound and 300-pound pressure classes . . . in both rising stem and non-rising stem patterns. Your local Crane Distributor has these valves in stock and can ship your order without delay.



THANKS TO EXELLOY SEATS, ONLY THE REPLACEABLE DISC GETS THE WEAR

Crane Exelloy (12% chromium steel) seat rings, expanded into body, give a hard bearing surface with superior resistance to wear, indentation, or scoring. Normal seating wear is shifted to the easily replaceable bronze wedge disc. Ordinary bronze valves wear on both disc and seat, an expensive maintenance factor. But with this Crane bronze valve you need only slip in a new disc to get a like-new, tight-seating valve.





"BEEFED-UP" BODY DEFIES DISTORTION TO MAINTAIN TIGHT SEAL

This Crane bronze gate valve has a cylindrical body . . . the best design to withstand internal pressures. Ordinary rectangular body design creates stress concentration at corners, which may result in distortion of the valve body causing leakage or early failure. Huskier, better integrated Crane design has more rigidity under strains, reinforces seats against wedging action of disc.

No. 424; 200 Pound
No. 634E; 300 Pound

CRANE®

Crane Co., Industrial Products Group, 4100 S. Kedzie Ave., Chicago 32, Ill.

VALVES • ELECTRONIC CONTROLS • PIPING • PLUMBING • HEATING • AIR CONDITIONING

FOR EFFICIENT ACTION LIKE THIS ON YOUR NEXT SHOT...

WHICH EXPLOSIVE?

Modern developments in mining are constantly aimed at cutting costs and improving safety. One fast road to lower operating costs is thru better use of explosives and blasting techniques. For blasting in open pits or in underground stopes, drifts or shafts, mine operators are finding that their lowest true blasting costs depend on determining which explosives, and which blasting methods, combine to give the most uniform fragmentation, the best displacement, and the lowest overall cost.

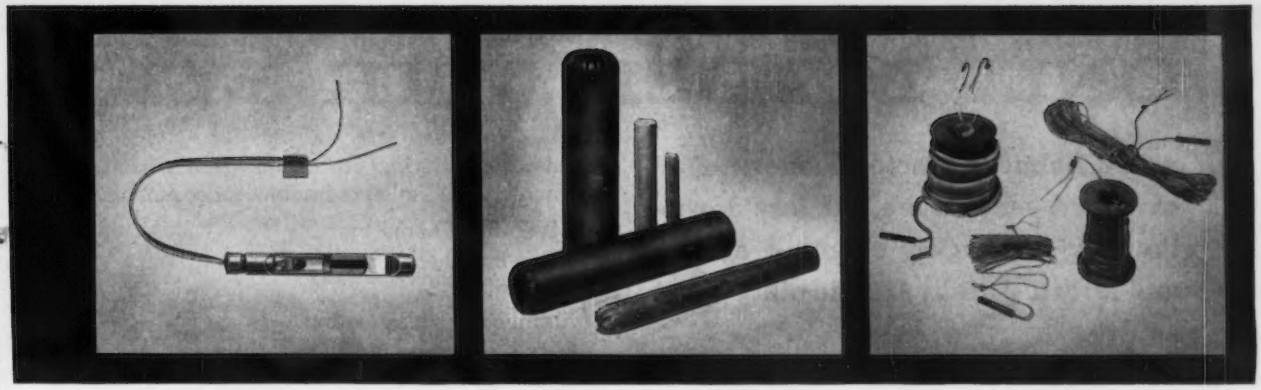
The complete Atlas line of explosives, blasting agents, and blasting supplies is designed to provide every possible combination to meet each type of blasting problem, over a wide range of conditions. For example, in addition to the four shown here, there are also such specially developed products as Amodyn,® available in both high and low velocity grades; Ammodyte,® a new economy dynamite; and Giant "75" Primers for efficient detonation of blasting agents. It will pay you to investigate these and the many other products in the complete Atlas line. And as for the latest blasting techniques, that's the job of your Atlas Representative. He can help you determine just which combination of explosives and blasting methods will give you the best results . . . on every shot.

Our blasting cost chart, slide rules and technical literature are designed to help you determine your lowest true blasting costs. Ask your Atlas Representative, or write directly to:

ATLAS POWDER COMPANY
Explosives Division, Wilmington 99, Delaware

When you use the right combination,
all your equipment
moves in sooner...
works faster...
produces more.

ATLAS PELLETS, a new form of ammonium nitrate, have both the density and sensitivity required for efficient ammonium nitrate blasting.

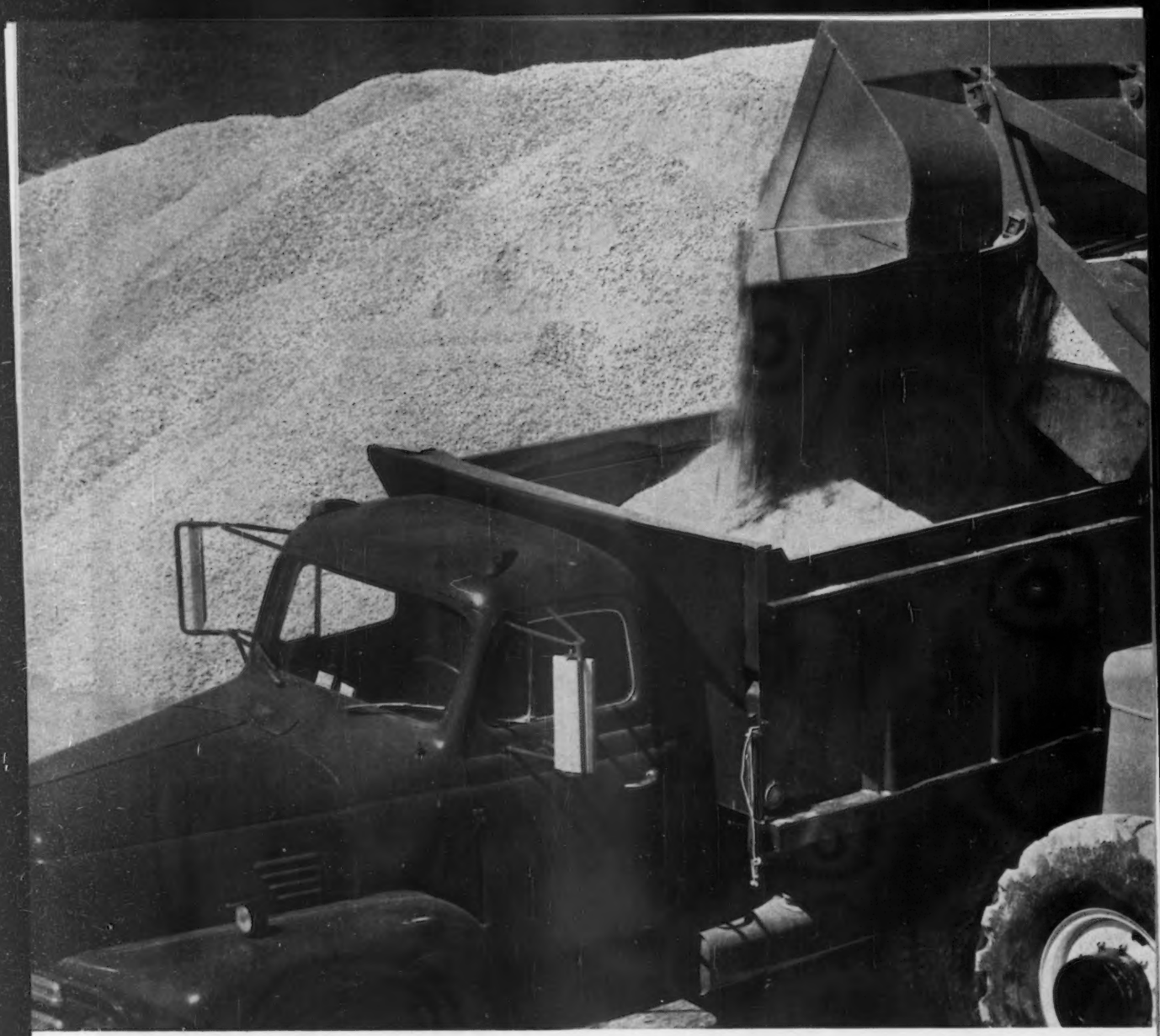


MANASITE® gasless delay electric blasting caps, most uniform timing in the field because of Atlas electric match and delay compound.

GIANT GELATINS for high velocity shattering action. They are advantageous for extremes of wet work and for hard, tight shooting.

ROCKMASTER® electric blasting caps achieve the staggered action so important in producing better breakage and control.

ATLAS EXPLOSIVES



ONLY LOADER WITH 5-WAY

Allis-Chalmers tractor loaders offer extended service life, far less down-time by thoroughly cleaning all air and filtering all hydraulic oil.

Unmatched filtering protection—that's what you get in all Allis-Chalmers tractor loader models.

Air is double filtered by:

1. air breather
2. air filter

Hydraulic oil is cleaned by:

3. full-flow micronic filter
4. conical screen
5. magnetic filter

This 5-way filtering protection brings peak hydraulic operating efficiency . . . extended service life.

move ahead with

HYDRAULIC PROTECTION

Complete filtering protection is just another way Allis-Chalmers tractor loaders set the pace in the loader field. They also feature: *pin-connected axles* that eliminate shifting and rolling under load; *exclusive single-lever control* of all speed and direction; *safe, well-located dump cylinders* that are up and away from dirt; *extra reach* for easier dumping and *added stability* for moving big loads without tipping or spilling.

Your Allis-Chalmers dealer can give you facts on all 5 tractor loader models—ranging in capacity from 1 to 5 cu yd, in power from 76.5 to 130 horsepower. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

... power for a growing world

KRUPP

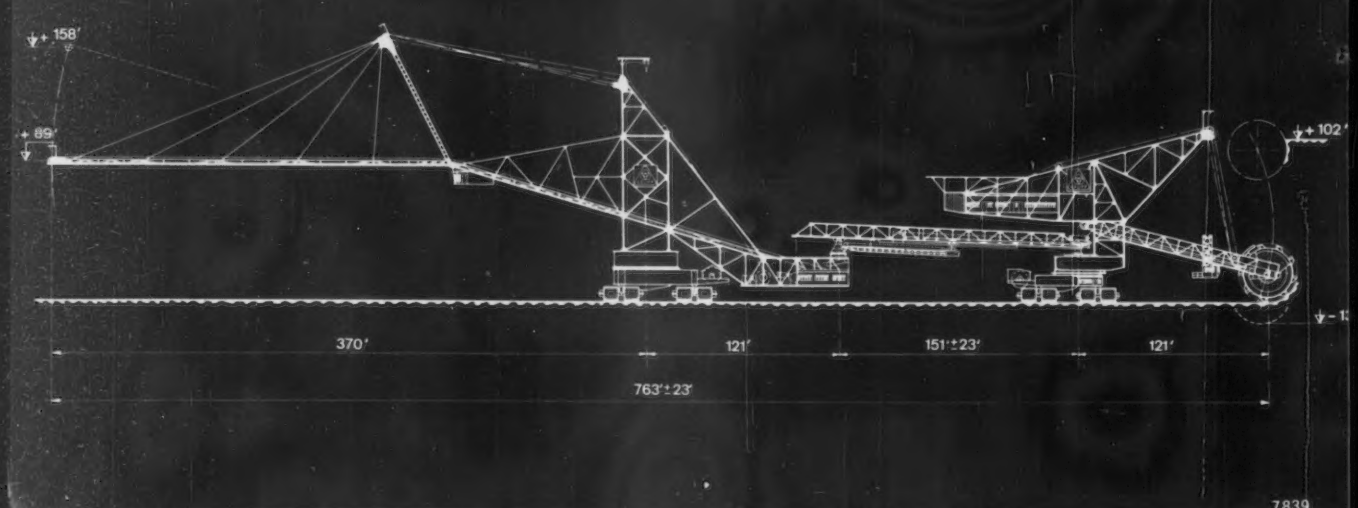
Krupp Bucket Wheel Excavator and Boom Stacker

strip-mining the lignite deposit of Arjuzanx (France). Bucket Wheel and Stacker are crawler-mounted and connected by a telescopic conveyor bridge. This combination enables an economical mining of thin lignite seams covered by relatively thick layers of overburden, whilst ensuring a large width of uncovered lignite reserve of approx. 215 ft.

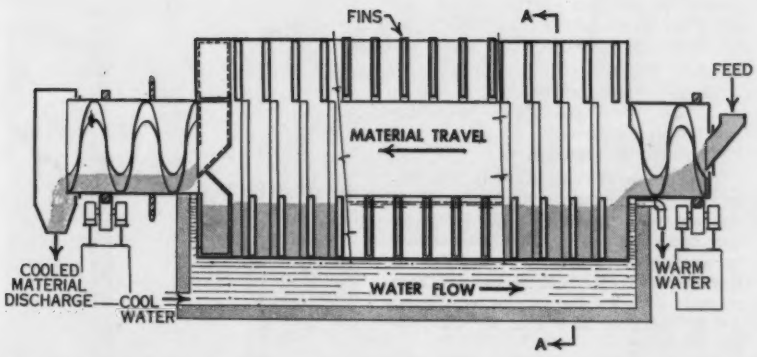
Maximum cutting height: 102 feet
Output: 1960 cu.yds. of solid soil per hour
Length of discharge boom: 370 feet
Overall length of plant: 786 feet
Year of build: 1959
Purchaser: Electricité de France

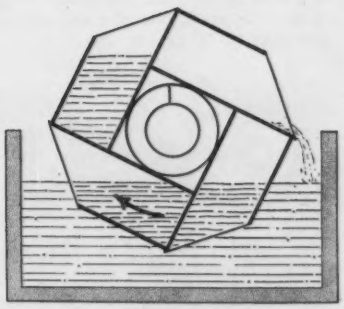
FRIED. KRUPP MASCHINEN- UND STAHLBAU RHEINHAUSEN

For information, please contact Krupp International Inc., 375 Park Avenue, New York 22, N. Y.



NEW PRODUCTS DIGEST



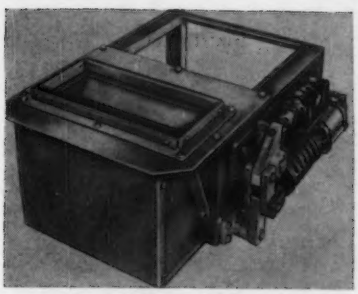


Spiral Cooler Does the Job in Minimum Space (1)

LINK-BELT'S ROTO-FIN COOLER (rotating drum with a series of flat, dual-purpose hollow fins lapped to form a spiral around the inside of the shell) can handle fine materials at high temperatures and cool them rapidly and efficiently.

The individual hollow fins, which Link-Belt calls cells, are separate heat exchangers, with openings on the drum's outer periphery. As the partly submerged drum rotates and as material is spiralled down its length, the cell openings continuously scoop up cold water and empty with each drum revolution to give heat transfer coefficients as high as 20 btu/hr/sq ft/°F on high temperature applications.

Link-Belt claims that Roto-Fin's parts have been kept to a minimum (no fans, dust collectors or controls) and that it is safe for high temperature applications (steam escapes through large hood stacks, not through restricted pipes).



Gravity Feeder (6)

TWO-SPEED gravity feeder which has been specifically designed to accurately handle free flowing, non-clogging materials (feed sand, plastics, etc.) is being introduced by Thayer Scale Corp.

Special feature of the new Vibragate—Series G—is the pneumatic vibrator mounted on the flow control gate. At slow or dribble flow, when most clogging takes place, the vibrator is actuated to always ensure an even material flow. At high speed, the flow control gate is fully opened and the material passes through unrestricted.

Iron Detector (4)

A NEW ANALYZER that can detect iron appearing as low as 250 parts per trillion and spot rust before it causes serious damage has been developed by Technicon Controls, Inc.

The instrument, called AutoAnalyzer, determines the iron content by the intense violet color which develops when ferrous iron complexes with tripyridyl (TPTZ).

In high-pressure, high-temperature operations (boilers and turbines), the new detector becomes a necessity. Rust and corrosion deposits, if not detected early enough, clog boiler tubes, lower system efficiency, and eventually require boiler blow-down. The lower the amount of iron traces that can be detected, the sooner a trend can be spotted and corrections made.

Technicon said that the system is self-cleaning, that results are obtained continuously without an attendant being present, and that the unknown is checked against a continuous stream of standard sample.

High-Capacity Sampler (9)

GELMAN INSTRUMENT CO. has developed a high capacity air sampler that collects dusts and aerosols in air at rates up to 200 cfm (twice that of previously available instruments).

The compact unit is easy to handle in the field, yet its cast aluminum housing and rotor, ball-bearing motor, and vibration-isolating suspension mounting make it sufficiently durable for any type operating condition. Gelman said that a new system of air measuring gives laboratory accuracy of flow measurement by means of a dial-reading orifice gage.

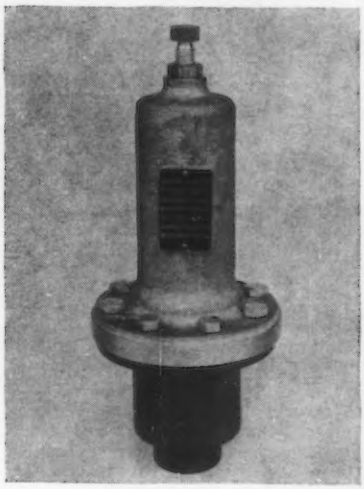
Vibration-Free Compressor (5)

NEW AIR COMPRESSOR, virtually vibration-free because of its stiff shaft design which operates below the critical speed, is the most efficient 4-stage integral gear centrifugal air compressor ever offered in the U.S., according to the Worthington Corp.

The integral gear design, the company said, allows direct coupling to a

low speed motor driver. This minimizes installation problems and reduces installation costs.

The firm also said that the quiet, lower maintenance compressors will be available in air-inlet capacities ranging from 4,000 to 30,000 cfm and discharge pressures of 60 to 105 psi.



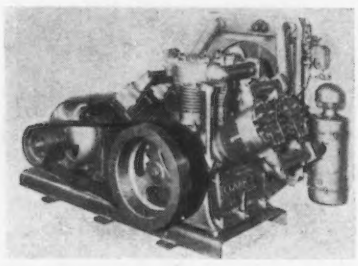
Polyvinyl Valve (7)

ATLAS VALVE CO. has announced what it calls the first relief valve with a polyvinyl chloride body for corrosive handling applications. Called the No. 1911 and produced in sizes up to 2 in., the valve shows great resistance to corrosive attack by acids, alkalis, salt solution, alcohol and many other chemicals.

The spring-loaded, diaphragm-actuated, single-seat relief valve can be used at temperatures to approximately 160°F and adjustable pressures to 120 psi. Atlas said that reduced pressure ranges are 5-15, 10-18 and 50-120 psi.

Correction

On page 44 of the New Products Digest for August, 1960, E&MJ referred to Magnetic Engineering & Mfg. Co's tramp iron magent at the WEMCO SE Series. It should have been referred to as the MEMCO SE Series Self Cleaning Magnet.



Air Compressors (3)

A NEW LINE of 100-lb air compressors in the 25- to 100-hp range has been introduced by Clark Bros. Co. The two-stage, air-cooled units (called the C line) are designed for compactness, durability and high efficiency.

Substantial savings are achieved in power consumption—units produce high compressor efficiency (intercooling between stages, generous valve areas, and large air passages).

Copper alloy core sections of the fin and tube, single-pass-type intercoolers can be readily removed for cleaning or replacement if required.

The company said that a constant speed load and unload device is part of the standard equipment. For intermittant operation, an optional dual control is available, permitting operation on start-stop duty for both motor and compressor, or may be set for continuous motor operation and free air compressor unloading.

Indestructible Rubber Tire (10)

PNEUMATIC INDUSTRIAL TIRE with two plies of steel cables imbedded in the rubber beneath the tread, and which is invulnerable to practically all puncturing objects, has been developed by the B. F. Goodrich Co.

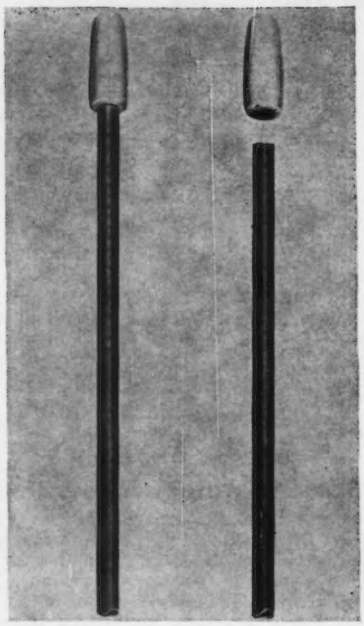
The tire is called the "Steel Protected Industrial Pneumatic" and Goodrich said that when tested in the severest possible on-the-job use, it outlasted standard industrial tires 6 to 1, and reduced punctures as much as 5 to 1.

Steel Protected Industrial Pneumatic is being made in sizes to fit all standard materials-handling equipment.

Rotary Bits (30)

AUSTIN D AND DV STYLES, two new rotary drill bits from Austin Powder Co., have oversized carbides multibonded in special alloy steel shanks. This, the company claims, will give full cutting faces while protecting bits from wear and damage.

The D may be ground more frequently than ordinary bits and is designed for all general work. Both styles are available in 1¾, 1⅞ and 2-in. dia.



Fuse End Enclosure (8)

HANDY PLUGS which slip over the ends of detonating fuses to prevent water absorption in bottom charges and other wet blast holes have been developed by the Austin Powder Co.

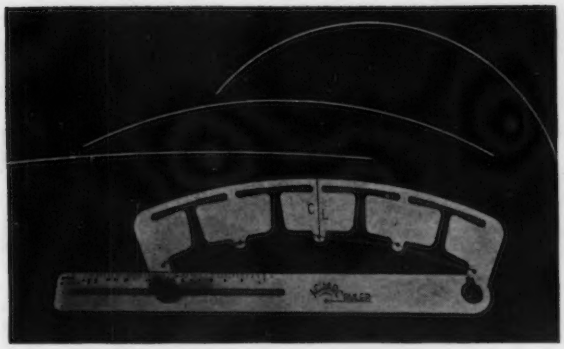
Watertight application, Austin said, consists simply of pushing the plastic fuse enclosure over fuse end. They are supplied 200 to a bag.

Huge Haulpak (31)

TWO NEW END DUMP TRUCKS, one with a 60-ton capacity, has filled out LeTourneau-Westinghouse's Haulpak line so that it now includes the entire size range for off-highway haulers. The latest models were introduced at the American Mining Congress Las Vegas October Mining Show.

Despite its size and hauling capacity, the LW Model 60 Haulpak weighs only 33 tons. A 550-hp Cummins diesel and Allison Torqmatic transmission with six forward speeds pull the monster to its top speed of 46.6 mph.

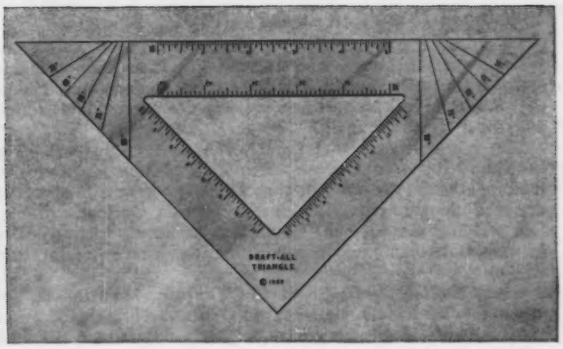
Model 60's ground clearance is almost twice that of conventional vehicles—standard axles and springs have been eliminated and the entire steering system is protected above or within the frame.



Arc Drawer (14)

ACU ARC RULER, which draws arcs of circles of any radius from 7 to 200 in. or more with ease, even if the center point is beyond the edge of the drawing surface, is being manufactured by the Fullerton Engineering Sales Co.

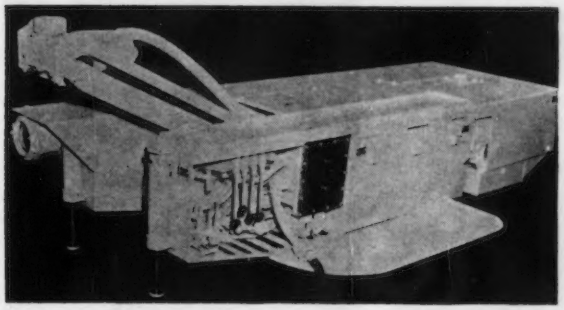
The new tool, Fullerton announced, eliminates the need for french curves, ships curves, splines and other arc-drawing devices.



All-Purpose Triangle (15)

DRAFT-TRIANGLE CO. has made a drawing instrument which combines the advantages of a protractor, straight edge, and scales and can be used to construct complete mechanical drawings.

Onto the 8-in. 45°/90° plastic triangle are stamped 1-in., ¼-in., ⅛-in., and ⅒-in. scales as well as guide lines for constructing 90°, 75°, 60°, 45°, and 30° line intersections.



One-Man Roof Bolter (13)

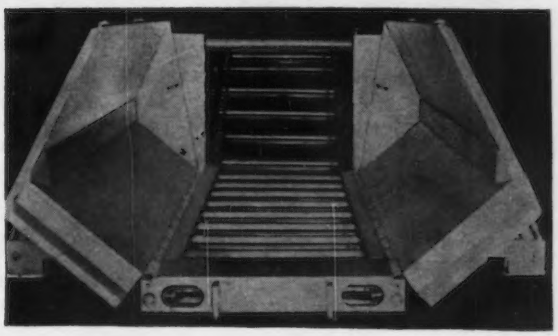
ONE MAN CAN DRILL the roof and set a bolt in a little over a minute with Long-Airdox Co.'s Model LRB roof bolting machine. The unit has a 42-in. lift, a 40-in. width and can turn in its own 108-in. length, which eases maneuvering in narrow runways and close timbering. The machine can also work in areas where other operations are being done.

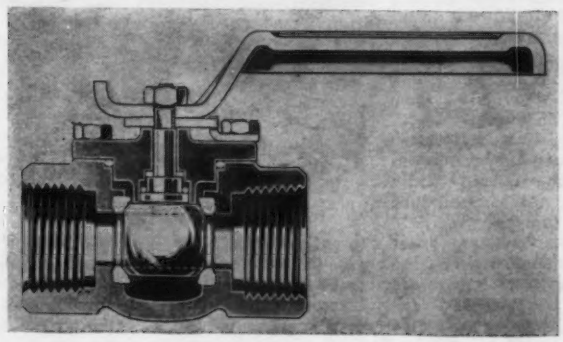
The LRB has a 27-in. height, which makes it possible to go into the tightest work areas. It speeds the roof bolting operation by being able to reposition from hole to hole in 25 sec. It trams at 140 fpm.

Speedy Car Feeder (12)

BELT AND CAR FEEDER, introduced by National Mine Service Co., lets any shuttle car dump its load at maximum speed—adds many tons and extra trips per shift.

The new 300 cu ft capacity machine is called TransFeeder and it feeds the shuttle car's load onto a belt or into a car at any desired rate. Shuttle car operator dumps the load onto the feeder and returns to the loader or continuous miner. After about 45 sec, the feeder sides begin to raise and force all of the dumped material onto a center conveyor. The sides stay hydraulically raised for about 45 sec while the entire load is conveyed to the belt or car and then return to their normal position. TransFeeder then stops automatically and is ready for the next loading cycle.





Improved Ball Valve (11)

LUNKENHEIMER CO. has developed a ball valve which they say incorporates all of the good features of previous models but which has been designed to cut down on frequent and impractical maintenance.

Top entry is what makes the easy in-line maintenance possible. Once the cover is removed, the ball (flat at top and bottom for quick removal) is taken out by the tool on the valve's specially designed handle. With the ball out, the seat can quickly be replaced without breaking the pipe.

Lunkenheimer said that the valve is being introduced in bronze body, screw ends, pipe sizes—¼ to 2 in., with Teflon or Buna-N seats and seals. It will soon be available in other materials as well.

Yieldable U-Section Arches (32)

COMMERCIAL SHEARING & STAMPING CO. is making yieldable steel arches with overlapping U-shaped sections and claims that it is the ideal support in extremely deep areas, fault zones, and other areas of stress.

The company said that though yieldable steel arches have been used for over 35 years, their arch contains an exclusive feature—the friction contact area which is confined to specially designed flanges and side webs to provide efficient, trouble-free yielding. As a result, Commercial said, no friction exists between horizontal webs and buckling under excessive pressure is eliminated.

Called the Commercial T-H (for Toussaint-Heintzmann, the original underground yieldable unit), the arch is made from special-quality, high-strength mine steel suitable for repeated cold working. Arch segments don't need much storage space, are easily handled and assembled, and can be quickly and economically installed. Commercial added that the yieldable arch is the only type support that can be profitably recovered and reshaped for further use.

Safety Switches (33)

TWO NEW SAFETY SWITCHES which are the first ones able to withstand short circuit energies of up to 200,000 amp, have been developed by General Electric's Circuit Protective Devices Department. They are designated Type TH (heavy duty) and Type THD (heavy duty interrupter) and are designed to be used with the company's CLF or other high current limiting fuses of comparable characteristics.

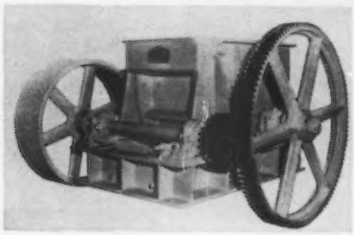
THD switches are available in ratings from 30 to 600 amp, 250 and 600 v a-c. Type TH devices, available in the same ratings, incorporate double-break contacts in a rugged phenolic rotor.

Single-Roll Crusher (16)

NEW SINGLE-ROLL CRUSHER with relatively large capacity to handle soft slate, shale, phosphate rock, limestone, etc., but which incorporates many design features developed for more severe-duty crushers, was recently introduced by the Pennsylvania Crusher Div., Bath Iron Works Corp.

The new Atlas unit reduces product size to maximum dimensions of 1½ to 8 in. It's available with roller dia of 18, 24 or 30 in. to handle feeds up to 26-in. thick.

According to the company, the new crusher incorporates the following design features: countered breaker plate to take the large feed sizes without clogging; simple, trouble-free adjustment of breaker plate by shims to set product



size; automatic toggle and torsion spring safety release to prevent damage from hard, uncrushable matter; and spherical, anti-friction roller bearings mounted in split housings outside the crusher frame where they are easily lubricated and inspected.

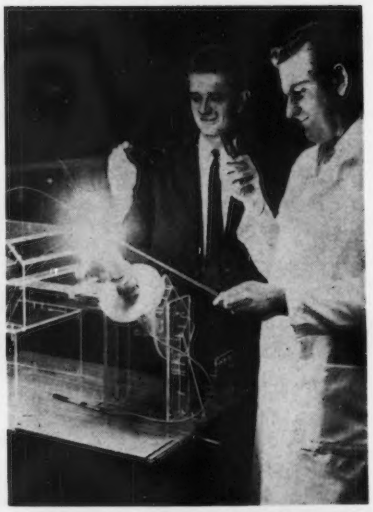
"Plasma" Cutters

ULTRA-HOT "PLASMAS" and their possible future uses were discussed in last month's E&MJ on pp 112-114.

Two companies have now announced plasma units which can cut through rock in a matter of seconds. Both work on the principle of using the energy of a high frequency electro-magnetic field to break up and ionize gas molecules into their component parts and then allow them to recombine into their original state.

Amperex Electron Corp.'s "Plasma Torch", while generating temperatures as high as 3,000°C, never overheats—it can last indefinitely. Only the electron tube will ever have to be replaced.

The other plasma cutter (lower photo), made by Plasmadyne Corp., has been put through a series of tests to see how effectively it can cut through a variety of rocks. The tool was not only able to cut through granite, but, by having its gas temperature lowered, could cause rocks to flow into desired shapes. (for "Plasma Torch", circle **35**; for Plasmadyne's unit, circle **36**).



For Your Files

This selected manufacturer's literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

WALLET-SIZE conversion tables for weight-volume, length-area, pressure, flow, temperature, gravity, base weight, and power has been compiled by the Ohmart Corp.

At a glance, the operator can convert centimeters to in., lb water to gal water, kg to lb, hp to ft lb/sec, kw to hp, psi to ft of water, gal per hr to bbls per day, etc. **(82)**

COMPLETE LINE of T. B. Wood's Sons Co. mechanical power transmission equipment is discussed in an eight-page catalog (23103). Booklet includes the company's pillow blocks, rigid couplings, sheaves, bushings, and variable speed drives. **(83)**

NEW CORE DRILL RIG, the Acker Presidente, can drill 4,500 ft and is described in a new 6-page folder from Soiltest, Inc.

The Acker Presidente is designed for rugged field service, versatile operation, and is available in both skid- and truck-mounted models. Soiltest's folder outlines some of the rig's special features—hydraulic drill head, octagonal spindle, heavy duty transmission and power train, and the special hydraulic circuit. **(84)**

LATEST, COMPLETE DETAILS of Primacord fuse is contained in Ensign-Bickford's 72-page manual and catalog, "Primacord Detonating Fuse, What it is—How to Use it".

The pocket size manual describes and illustrates the company's six standard brands of detonating fuse, and outlines the approved operations in priming, loading and hooking up Primacord for instantaneous and delayed firing. **(85)**

"WATER BILL U.S.A." is a 16-page booklet recently published by Caterpillar Tractor Co. which looks into the problem water wastage in the U.S. and what can and must be done to prevent it.

Caterpillar claims that the national water problem becomes more acute each day and that, if no one paid it any serious attention, it could become a national emergency. **(86)**

COLORADO FUEL & IRON CORP. has just issued an 84-page revised edition of its Wickwire wire rope slings catalog. In addition to giving detailed specifications of the complete Wickwire wire rope line, the catalog has a separate section devoted to each of the major types of Wickwire slings. In addition, the booklet contains information on how to choose and use the slings with illustrated instructions on the basic rules of hitching. **(87)**

COMPLETE LINE of dial indicating receiver guages offered by U.S. Guage, Div. of American Machine & Metals, Inc. is being displayed in the new eight-page Catalog 520. **(90)**

WEMCO'S NEW BULLETIN (F5-B32) describes the principle of the flotation process for selectively separating finely divided mineral particles. The bulletin also describes construction and operating characteristics of the company's Fagergren flotation cells. **(91)**

TWO RECORD BOOKS, one to keep tab on truck costs and the other to help truck users evaluate the performance of their equipment, have been prepared and are available from International Harvester Co.

The 20-page truck record book (form AD-20) keeps an account of all fixed, operating and maintenance charges against one truck for a full year.

Form AD-26, the driver daily report, may be used in conjunction with the truck cost record book and has space for reporting information of number of trips, trip time, number of stops, mileage, loads, and fuel and oil consumption. **(92)**

NATIONAL SAFETY COUNCIL has just published two booklets outlining common winter driving hazards and what can be done to prevent them. The Council also outlined vehicle winter care and maintenance.

Data for the new booklets were obtained through actual driving tests during the harshest mid-winter conditions. The tests were begun in 1939 and are held each year. **(88)**

DUAL-HITCH automatic dragline bucket is described in a new leaflet from Page Engineering Co.

Page said that the Dual-Hitch can

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ENGINEERING & MINING JOURNAL
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No. 1

be adjusted in minutes to dig at any desired depth above or below the fairlead with the same degree of digging efficiency and capacity. **(89)**

ALL OF THE MICHIGAN construction and bulk materials handling equipment manufactured by the Construction Machinery Div., Clark Equipment Co., is illustrated and described in a professionally-prepared 28-page, four-color bulletin (150-A).

One of the new catalog's sections describes the Clark power train basic to all Michigan machines. **(93)**

GELMAN INSTRUMENT CO.'S intelligently prepared Manual No. 12 outlines procedures for determination of contamination in hydrocarbons and hydraulic fluids. Both of the procedures depend on filtration through a membrane filter and subsequent microscopic observation. Gelman said that a tentative ASTM procedure recommends examination of contaminants by transmitted light. **(94)**

HUGE VOLUMES OF WATER can be effectively regulated by pumps described in a new bulletin from Peerless Pump, Hydrodynamics Div., Food Machinery & Chemical Corp.

The company has them tradenamed "Hydro-Foil" and they are available in two types—one an axial flow propellor type pump and the other a mixed flow type pump. According to Peerless, both are available in single or multi-stage designs. **(95)**

APPLICATION, SELECTION and order information for the new line of "radicon" enclosed fan-cooled worm gear drives recently introduced by Foote Bros. Gear & Machine Corp. are detailed in a new "Engineering Catalog RCB." **(96)**

CLARKSON CO.'S new Series C valve which controls the flow of abrasive slurries and corrosive pulps, is presented in the new bulletin 6060V. **(97)**

BULLETIN NO. 271, "AAF Equipment for the Control of Dust", describes the complete line of dust-control machinery made by American Air Filter Co.

The four main types of dust controllers (dry centrifugals, wet collectors, fabric collectors and electrostatic precipitators) are represented and illustrated by 13 differs AAF products—bulletin shows their capacities, and their specific applications. **(98)**

LINK-BELT CO. has recently published a six-page folder (2745) to describe their new one-man operated railroad car shaker.

The shaker mechanism, Link-Belt said, transmits low-frequency vibrations to the top of car sides, parallel to the car's horizontal axis and in the direction of maximum strength and can empty hopper bottom cars at the rate of 8 to 10 an hour. **(99)**

PEERLESS PUMP DIV., Food Machinery & Chemical Corp.'s new 20-page booklet, "Useful Pumping & Hydraulic Engineering Data", contains a wealth of basic information on pumps, pipes, belt drives, motor wiring, etc.

Peerless starts the presentation with a page of pump term definitions. Valuable data about pumping liquids other than water, effect in centrifugal pumps of change of speed, and field-testing methods follow.

Some of the other major headings include: orifice charts and pipe weights and dimensions, formulae for determining cost of electrical pumping, simple method of surveying a deep well, quart-turn belt drives, mechanical and electrical equivalents, and a pipe friction-loss chart. **(100)**

SAUERMAN BROS. INC. has prepared an informative 25-page booklet which outlines and illustrates Drag-Scraper machines and accessories at installations all over the world. **(79)**

NEW 12-PAGE bulletin (CDAT-1) illustrating and describing drilling rigs for all rock jobs has been published by the Gardner-Denver Co.

Swing boom and crawler drills, and five models of the company's Air Trac are included in the presentation. G-D also discusses the PR123J Rock Drill which features independent rotation, faster drilling, rotational control and improved lubrication for both rotation motor and drill. **(81)**

ROCK CRUSHER with only one moving part, the "Pulvo-Matic," is presented by the Frog, Switch & Mfg. Co.'s four-page two-color bulletin.

The firm said that the unit's cast manganese-steel rotor cage works in conjunction with manganese-steel liner plates to reduce the material to graded sizes. The bulletin gives the approximate weight, required size and hp for the three crusher types. **(80)**

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ENGINEERING & MINING JOURNAL

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Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...

Raw Materials? Your final decision to expand or build results from a series of important individual decisions. Raw material availability is one of them. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. In addition, KE is an experienced designer and builder of all types of facilities for the Minerals industry. From Pre-Engineering through design and construction Kaiser Engineers provides complete one-company service and ingenuity based on years of experience.

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"Our TD-25's *deliver* 25% than the '24's' they

—Tommy Belville, *for Belville Mining Company, Inc.,*

more load replace"

Ironton, Ohio

"Our three International TD-25's are delivering 25% additional load, compared with previously-owned TD-24's," reports Belville Mining Company, Inc. "The TD-25 has more power to work at faster speeds without loss of motion.

"Another big advantage of the TD-25, mighty important in outcrop cutting, is you can back it up extreme grades at the faster speeds without changing gears."

"Belville" teams "25's" with a 7-cu yd dragline and a 2½-cu yd stripping shovel—to remove overburden as deep as 60 feet. The tractors are also used to level for the shovels, clean coal, construct roads.

"Live track" power-steering!

Like the TD-24, the TD-25 gives you exclusive "live track" Planet Power-steering—to make full-load, full-power turns, or slam straight ahead with offset loads. With combined on-the-go, HI-Lo power-shifting, you get instant, up-or-down matching of power to condition.

You turn with the dozer fully loaded, without spillage. You get constant-contact benching or highwalling, applying full power, getting full speed. You eliminate "dead-track drag" and "gear-shift lag."

With exclusive new International DT-817 Diesel engine wallop, the "25" bulls along, 230 turbocharged hp strong—without "slow-motion" lug-downs. New TD-25 seven-roller tracks are strength-matched to full engine effort. And the "25" is platformed on super-rugged double-box-beam frames to meet slam-bang conditions!

See what it means in extra profits to beat the famous TD-24 by 25% or more. Compare planet-drive "25" ability to outearn king-size clutch-steered rigs by amazing margins—clearing land, blading rock, benching, mass-production overburden removal. Let your International Construction Equipment Distributor demonstrate.

Benching an access road on a 1-to-1, or steeper, mountain slope. The operator of this Belville-owned TD-25 takes maximum advantage of "live track" Planet Power-steering—to gouge out stumps and boulders and cut shale—without "bank-nosing" or sluing. He simply operates the bank-side track in high-speed range, the other in low-speed range—for full-capacity, straight-ahead performance.

International®
Construction
Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

Two of "Belville's" TD-25's remove up to 50% of the overburden from a coal seam—produce 25% more than the "24's" replaced. Only simplified TD-25 planetary design gives you "live track" power-steering *and* on-the-go power-shifting.

How the clam-action 4-in-1 gives you "equipment spread" utility with a one-

Move the "machine action" selector lever—see for yourself how the International Drott 4-in-1 gives you four big-capacity actions. See how each of the four actions "doubles" for one or more special-duty machines. And each action gives you an amazing range of job-handling working positions. Prove that the 4-in-1 saves you the cost of additional machines and of hiring extra operators. Compare how exclusive, shock-swallowing Hydro-Spring protects performance; prolongs 4-in-1 life. Let your International Drott Distributor demonstrate!

Let the 4-in-1 double for a boom-type shovel in many conditions—as this operator does! Here, his 1⅛ yd TD-6 Four-in-One applies famous pry-over-shoe break-out action to "dig" materials without shooting. The 4-in-1 also uncovers and cleans the seam, and loads out the materials.

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL® DROTT®

Strip-off dirt with inch-close accuracy, using 4-in-1 "carry-type scraper" action. Watch the earth "boil" in, as this 1½-cu yd TD-9 Four-in-One does precise work. Use this action, also, to strip layers of materials accurately.

You get a full-capacity, earth-rolling bulldozer simply by opening the 4-in-1's clam—with 2-finger hydraulic lever ease. This TD-15 Four-in-One is clearing off brush and removing overburden from a deposit of sub-base materials. Four-in-One can double for a specialized dozer, 'most anywhere!

. . .

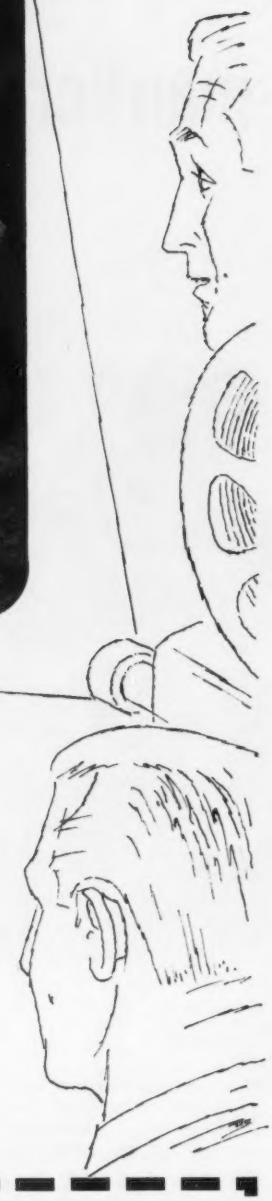
man "crew"!

You can back-drag materials wholesale (and safely) from the sand, clay, or gravel bank. And grade hard-to-get-at slopes, with easily-controlled 4-in-1 back-drag action. It's the 2¼-cu yd TD-15 pulling down select sub-base materials by the truckload!

End sticky materials problems for good, the way dredging contractors do: with positive clam-action bottom-dumping. Note how opening the 4-in-1's clam pulls material from bucket surfaces —and gravity down-pull does the rest, to enforce positive, self-cleanout dumping.

Place the open clam over materials, even rock—close it, and fill the bucket in one fast gulp! Picture shows a 4-in-1 picking up and clearing shot-rock piles from sump-pump intakes—so pockets of water can be pumped out and quarry operations resumed!

Grabbing heavy, "Siamese-twin" stumps shows another way exclusive 4-in-1 clam-action "bite" does profitable work ordinary loaders can't touch! You grab, carry, and load heavy, unwieldy "impossibles" including boulders or slabs of rock—without delay or extra help!



Underground filmed report shows how one mine moves hard rock for less than 20¢ a ton . . .

You have probably heard of the Young Mine of American Zinc, Lead and Smelting Company and wanted to see their operation. It is believed to be one of the world's most economically-operated hard rock mines. Many have come to observe their methods, several from foreign countries. This mine operates two shifts. A total of only 95 hourly employees produce more than 3,000 tons daily. The low cost operation is the primary result of the tremendous tonnage moved by self-loading transports manufactured by Sanford-Day. Three of these S-D Transloaders, requiring only three men per shift, load, haul, and dump all the ore produced. Total cost is less than 20¢ a ton. This includes cost of original investment, maintenance and labor. Another feature of this mine that visitors observe and ask questions about with a great deal of interest is the haulage equipment. Only 28 S-D Automatic Bottom Dumping mine cars are necessary to haul the entire 3,000-ton daily production to tipple and it costs less than 4¢ a ton. We recently completed and have available now for your study a documentary 18-minute color-sound 16mm movie showing every phase of this low cost operation — from drilling to transportation of ore to mill. Ask us to mail this film to you for showing to your operating personnel . . . or, ask us to have one of our representatives bring projector and the movie to show for you. Write or call us today. Use coupon below to make mail request.

SANFORD-DAY • P. O. Box 1511 • Knoxville, Tenn.

☐ We have sound projector. Please mail film "One Man! One Machine! LOAD HAUL DUMP" direct for review and study.

☐ Please have your representative contact me. We would like to have him visit us to show the movie "One Man! One Machine! LOAD HAUL DUMP"

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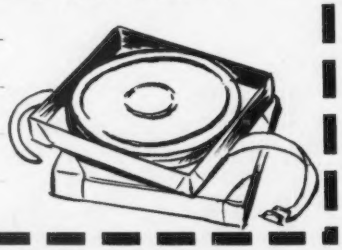

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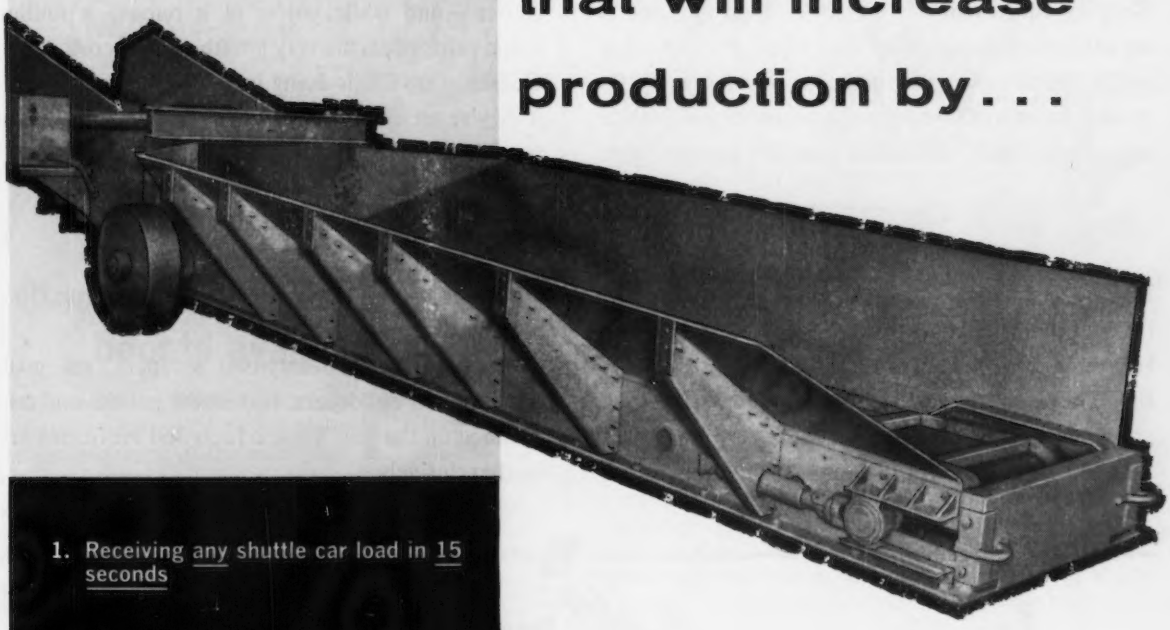
A belt feeder that will increase production by...



1. Receiving any shuttle car load in 15 seconds
2. Feeding the belt at any desired rate
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The *Positive Performance* Jamison Belt Feeder—a new concept in material transportation—gives you more profit dollars from your mining operation. Engineered, developed and proven by Jamison, the *Positive Performance* belt feeder makes increased production at lower cost a reality.

Simplicity of design permits virtually maintenance-free operation, and labor costs are cut substantially through reduced belt maintenance.

Shuttle cars can discharge continuously into the system, which has no maximum input limit. Output is easily regulated; the reduction ratio is limitless and can be tailored to your specific needs.

For detailed information concerning the applications of the *Positive Performance* Jamison Belt Feeder for your mining operations, write today.

JFI

HUNKERS, PENNSYLVANIA

JAMISON FEEDER, INC.

TELEPHONE: WAlker 5-7200

LUBE LOGIC

These four tips

Keeping equipment on the job 92% of the time is an achievement anywhere. But when you can do it while operating in sandstorm country, over 12% grades out of a 300′ deep pit to an additional 200′ to top of spoil area, 100 miles from the nearest parts source – and while you're at it remove a million cubic yards of earth every month, it's a record. Maco Construction Co. is doing it right now, and in doing it they've set up such a fine maintenance routine that we think it'll be a help to you to read about it.

What Maco is doing

Maco Construction Co. is stripping the over-burden from uranium deposits recently located in the Gas Hills area of central Wyoming for Western Nuclear, Inc. This is the largest strip mining operation ever attempted in the state, and calls for the removal of 25,000,000 cubic yards of over-burden. In this large open pit, the uranium ore lies from 250′ to 300′ below grade.

Maco is using twenty-two scrapers, six push tractors, two bulldozers, two motor patrols and one backhoe on the job. Texaco fuels and lubricants are used exclusively.

Clean-sweep lube rig handles two machines at once

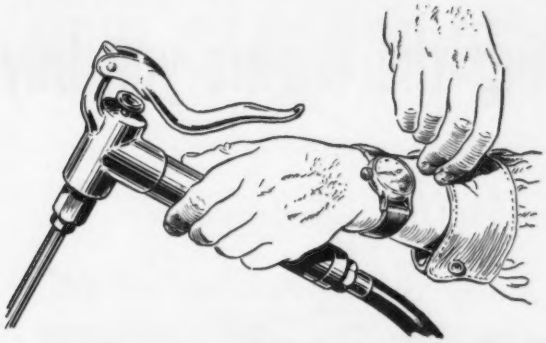
Maco personnel designed and developed a lube rig for this job that is just about as complete as they come – and it has the extra advantage of being able to service two pieces of equipment simultaneously, to make the most of the short period between shifts.

The rig is mounted on a 2 ton van that's kept warm in winter with waste heat from compressor and generator engines. It has two sets of hose reels, one on each side, so that two men can lubricate two different machines at the same time.

Since Maco has a Texaco Simplified Lube Plan, the rig can accommodate sufficient lubricant inventory for the project. Air motors drive the lubricant pumps, and a separate electric air compressor furnishes air. A 25 KW diesel generator set mounted in the van provides power for air compressors, power pumps and the four big floodlights. Maco personnel built the tanks that hold motor oil and hydraulic fluid; transmission and lube grease are pumped direct from original containers.

With this lube rig it's possible for the maintenance crew to lubricate all major equipment in the three hour period between shifts, so no work time is lost.

achieved 92% average availability



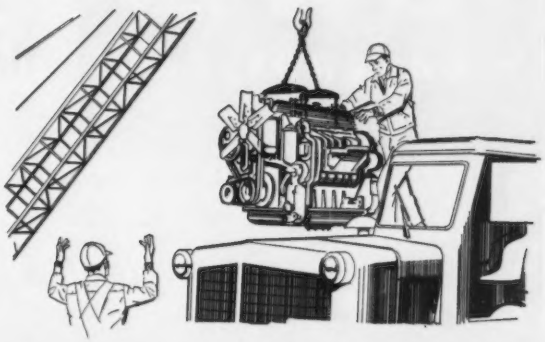
Clockwork lube scheduling boosts availability

Every machine on Maco's spread is serviced every day, in the period between the close of the day shift, at 4:30, and the beginning of the night shift, at 7:30. The 22 scrapers are lined up in a double row, and the mobile rig passes between them. Every machine is lubricated completely, and air filters are cleaned, at the end of every 10-hour shift. Crankcases are drained every 100 hours. Lube interval on gearboxes and torque converters is 2000 hours.

Simplified Lubrication Plan protects 33 major units with only five products

TEXACO SIMPLIFIED LUBRICATION PLAN		
1	Ursa Oil Heavy Duty:	engine crankcases
2	Havoline Motor Oil 10W:	Euclid Torquomatic Drive
3	Universal Gear Lubricant EP:	all gear boxes and final drives
4	Crater 2X Fluid:	open gears and wire rope
5	Marfak Multipurpose:	chassis and track rolls

With their Texaco Simplified Lubrication Plan, Maco gets fast, thorough, systematic lubrication for all major equipment with the smallest possible lube inventory. This inventory simplifies and speeds up application routine because it avoids confusion, minimizes downtime due to misapplication of lubricants, and lets Maco put their lube inventory on the mobile rig for complete on-the-spot coverage.



Replace-don't-repair theory cuts shop time

Although Maco is well equipped to handle emergency repair on the job, they cut shoptime drastically by sticking to an exchange system on major components like engines, transmissions and torque converters. Duplicate spares of these units are kept on hand. Then the defective unit is simply removed intact from the machine and replaced with a new or rebuilt one. All major repairs on engines, transmissions and torque converters are done at the Rawlins shops. Parts are flown in via Maco's own plane from headquarters in Rawlins, Wyoming.

Minimum downtime on equipment is the principal advantage of the exchange system, but not the only one. For instance, engine repairs can all be made in a fully equipped shop, without having to rush or make temporary repairs; and this system also ensures full availability of the field maintenance crew for their routine work.

Texaco Lubrication Engineers

There are 2,300 Texaco Distributing Plants in the U. S. ready at any time to help you develop a Texaco Simplified Lubrication Plan for your next job. Since every Texaco Plan is designed to lubricate specific equipment on a specific job, you'll get the best results by consulting a Texaco Lubrication Engineer. Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

TEXACO

Throughout the United States
Canada • Latin America • West Africa

engine power
BY CATERPILLAR

Measure the depth of service backing the engine you buy

Caterpillar Engine Dealers maintain complete facilities, so contractors can have the service they want, when they want it.

Too thin a line of service behind the engine you buy can eat away the profitability of the finest engine ever built. The speed with which you get parts and service, the skill of the mechanics, and the attitude of the engine dealers toward service responsibility can affect the amount of profit you make. Lacking in just one of these areas can cause an engine to bite into your profits because of unnecessary down time.

This is why, from Caterpillar, you get service in depth, service that gives you full value for every engine dollar you spend. The men who work on Caterpillar Engines are factory trained and, in turn, given intensive training by Caterpillar Dealers.

You'll find that Caterpillar Dealers maintain completely equipped facilities including steam cleaning and painting equipment for fast, complete service.

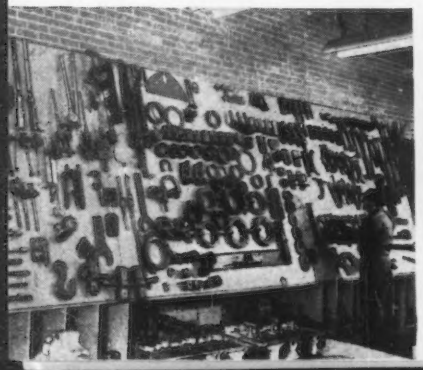
Quick, local service means parts availability for any Caterpillar Engine—and always at regular prices. See your nearest Caterpillar Dealer and inspect his facilities yourself. You'll see why the *total* cost of a Cat Engine—the initial cost plus operating and maintenance expenses—is the lowest. Call him today.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Engine Division, Caterpillar Tractor Co., Peoria, Ill., U.S.A.

Caterpillar service includes complete tooling **to handle any engine repair job. Facilities are adequate to give you immediate service.**



Caterpillar Dealer engine service is world-wide **and many of the vehicles in a dealer's fleet are used for round-the-clock service to give you immediate attention and minimize your down time.**

Complete stocks of engine parts **you can trust are available from your Caterpillar Dealer. Factory-owned supply depots back up dealers.**

Never before drill steel like this!

NEW GARDNER-DENVER *HI-LEED* STEEL

Drillers who have used this unique and revolutionary Gardner-Denver thread design are enthusiastic about its convenience and economy. Give it a try on your own rock drills—you'll soon see why. Call your Gardner-Denver drill steel specialist, or write for new bulletin on HI-LEED steel.

Only Gardner-Denver *HI-LEED* drill steel gives you all these field-proved advantages

ALWAYS UNCOUPLES BY HAND

New HI-LEED thread design makes wrenching unnecessary. Gardner-Denver engineers have incorporated field-proved reverse buttress design into an entirely new thread form that always uncouples by hand.

CUTS DRILLING TIME ON EVERY HOLE

HI-LEED steel saves time in adding rod . . . and ease of uncoupling, without use of wrenches, helps drill hole faster.

SENDS MORE IMPACT TO THE BIT

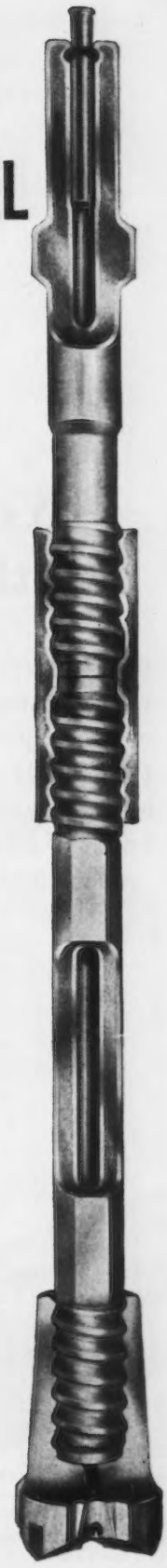
HI-LEED sectional steel transmits drill impact almost as well as a solid rod. That's because precision-milled threads on rod and coupling are in close contact over a large total area, thus holding rod ends firmly together.

DRILLS MORE FOOTAGE PER ROD

HI-LEED rods are designed to last longer than any other sectional steel, and the wide thread peak assures maximum wear. Carburizing and shot-peening give the steel a hard surface and tough inner core.

PREVENTS LOST HOLES

New HI-LEED design keeps mating parts snug—rods won't uncouple in the hole or while pulling out. Other thread forms may not hold a tight connection and many rod strings have been lost in the hole while pulling out with rotation on.



EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois

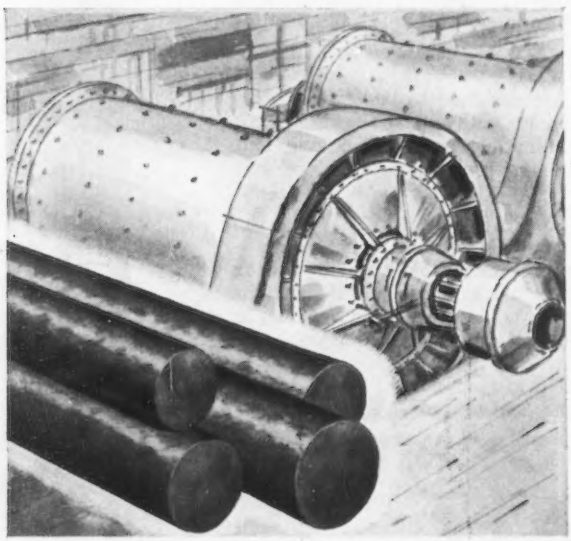
International Division, 233 Broadway, New York 7, New York

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

You get these ADVANTAGES with CF&I MINING PRODUCTS

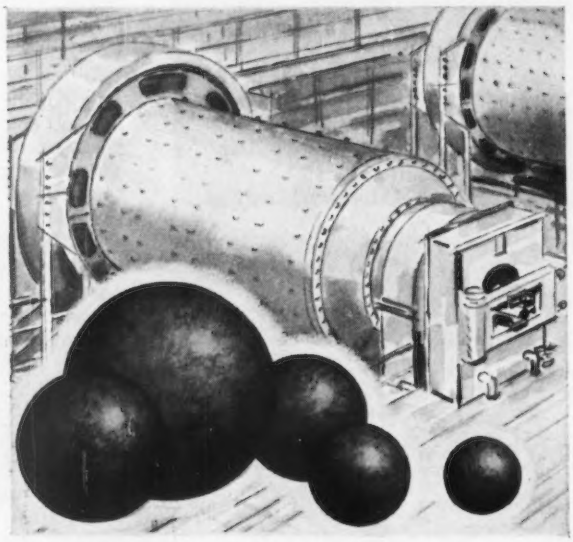
CF&I offers the mining industry a wide range of steel products designed to help increase output while maintaining safe operations. This combination of economy and safety is another of the implications of the Image of CF&I.

CF&I Mining Products are fabricated from steels produced in CF&I's own mills. Every product is tested, controlled and inspected during each successive step of manufacture to meet and exceed the highest standards of the mining industry. In actual operation, each CF&I Mining Product provides the following advantages.



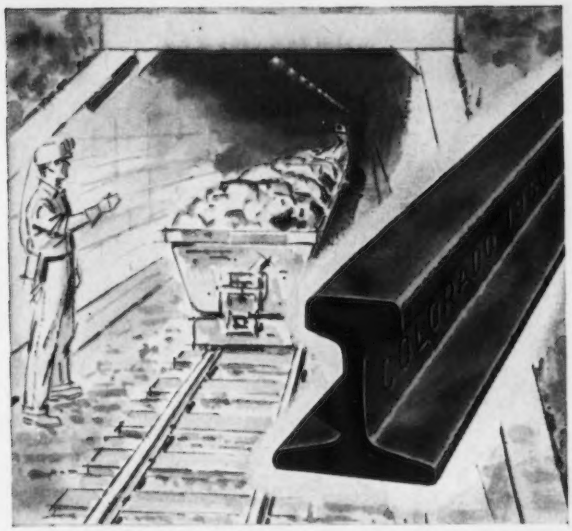
CF&I GRINDING RODS: Hot-rolled and machine-straightened from special analysis steels, in 1½" to 4" diameters (in ½" increments) and any length required.

ADVANTAGES: Maximum resistance to abrasion and bending. Extra-long service life.



CF&I GRINDING BALLS: Made from high carbon steels, chemically controlled to attain maximum hardness and toughness, in sizes ¾" to 5".

ADVANTAGES: Resist abrasion and withstand impact—grind more at lower cost.



CF&I MINE RAIL AND FASTENINGS: Rails available in weights from 12 to 45 pounds per yard. Fastenings include splice bars, angle bars, spikes, track bolts and nuts (square and hexagonal).

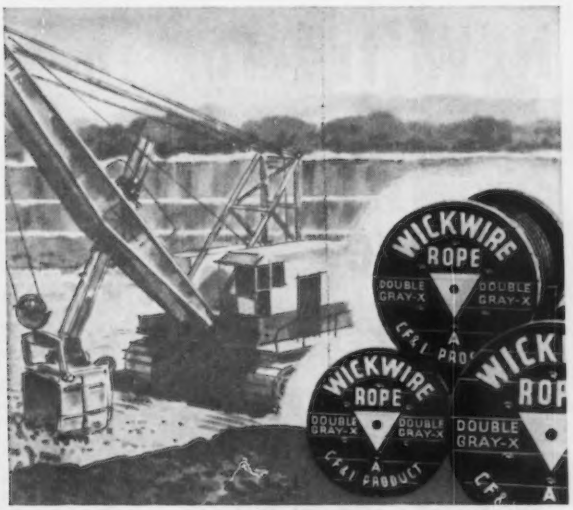
ADVANTAGE: Rails tailored to your individual requirements.

CF&I ROCK BOLTS AND REALOCK METALLIC FABRIC: Rock Bolts with Pattin shells (left or right hand threaded) available in 5/8", 3/4" and 7/8" sizes, from 24" to 120" long; also 1" slot and wedge type. Use with Realock Metallic Fabric.

ADVANTAGE: Achieve safe, economical, permanent ground support.

CF&I SPACE SCREENS: Your choice of metals, weaves, meshes and edge arrangements. For maximum volume or absolute screening accuracy, there's a CF&I Space Screen available.

ADVANTAGE: Space Screens that exceed your most exacting requirements.



CF&I-WICKWIRE WIRE ROPE: Available in all sizes, constructions and grades for every mining application. A new Wickwire development—Double Gray®-X rope—has **extra-high** strength. In addition, a new wire drawing process employing molysulfide* builds a permanent molecular protective shield around every wire in Double Gray-X, giving this rope a **longer service life.**

ADVANTAGE: Wire ropes that make no bargain with safety.
*Registered Trademark of Climax Molybdenum Co.

For complete information on any CF&I Mining Product, contact your local CF&I sales office, or write for catalogs.

THE COLORADO FUEL AND IRON CORPORATION

In the West: **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise • Butte • Denver
El Paso • Ft. Worth • Houston • Kansas City • Lincoln • Los Angeles • Oakland • Oklahoma City • Phoenix • Portland • Pueblo
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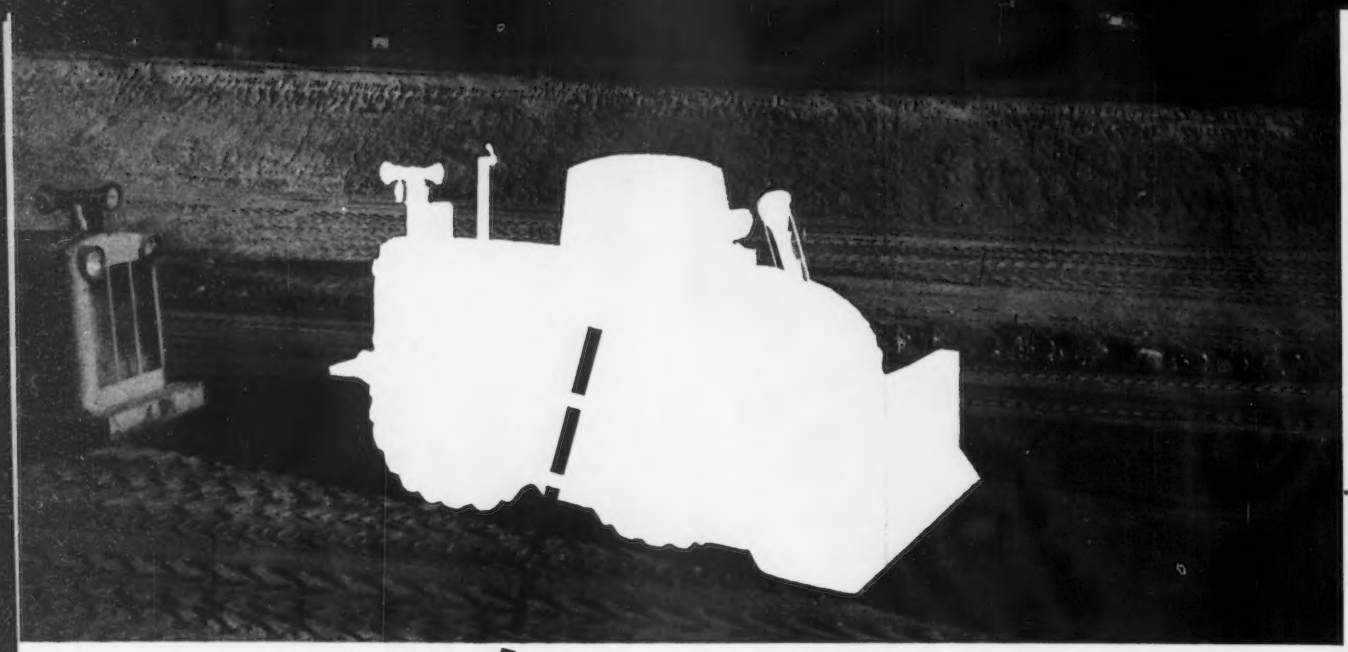
CF&I STEEL



There's a NEW tractor in your production picture

Take a close look at this new LeTourneau-Westinghouse C Tournatractor®. Here's *new V-Power performance . . . new faster speeds . . . new hydraulic control . . . new agility.* All offer a *new high in production efficiency* for your tractor assignments.

Since the first Tournatractor was put to work over 14 years ago, knowledge gained on every possible tractor application has led to continuous improvement in mechanical efficiency and performance. Result: with today's new, V-Power Tournatractor you get the *only* thoroughly job-proved, rubber-tired tractor available for heavy-duty work.

Quick facts on the NEW V-Power C Tournatractor

ENGINE: New GM V-Power diesel (6V-71) producing 218 hp.

TRANSMISSION: Power shift, air-actuated with torque converter, 4 speeds forward to 18.5 mph, 2 reverse to 6.2 mph.

CONTROL: New, efficient high-pressure hydraulic system offers instant, effortless control of attachments.

POWER TAKE OFF: Mechanical, SAE std. 1400 rpm.

DIMENSIONS, w/o attachments: 13'6" long, 10'6" wide, 7'8" high (to top of exhaust stack), 15¾" ground clearance, 6' wheelbase.

WEIGHT: 34,000 lbs. (with bulldozer only).

ATTACHMENTS: Bulldozer and Angledozer® blade, coal blade, rock blade, snow plow, front and rear push blocks, root rake, rear-mounted RR coupler.

Before you buy your next tractor, get complete details on the NEW Tournatractor. Your LW Distributor will be happy to demonstrate.

CT-2353-G-1

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Study of specifications and detail engineering.

Excavation for shaft collar.

Completed 700' shaft, concrete lined.

Crew readying for underground blast.

Underground control center.

Equipment lowered underground, readied for start-up.

Ready to go!

WKE GOES UNDERGROUND FOR U. S. GYPSUM

SPECIFICATIONS:

8' Air Shaft, 616' deep, concrete lined.
15' Mine Shaft, 700' deep, steel and concrete lined.
Mining System . . . room and pillar with shuttle cars.
All underground crushing and mining equipment.
Electrical control center.
Start-up operations.

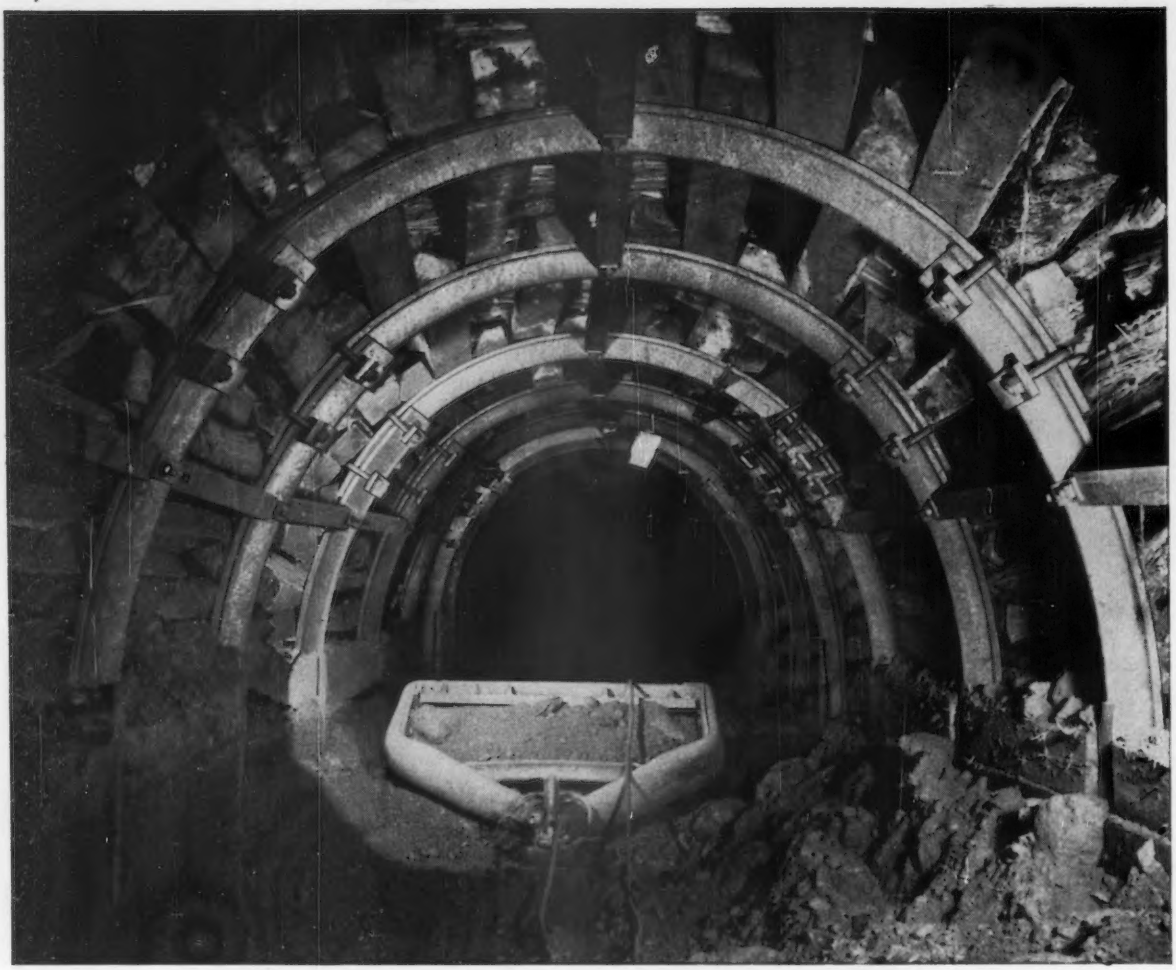
STEP BY STEP:

Sound, cost-saving mine development and construction by W K E . . .

- *Consultation*
- *Economic and feasibility studies*
- *Geologic studies*
- *Planning and budgeting*
- *Surveying and sampling programs*
- *Mine layout and engineering*
- *Shaft sinking and mine development*

Consult the men of W K E for an economic, realistic approach to mine development problems. Ask for more information.

W K E ®
WESTERN KNAPP ENGINEERING CO.
SAN FRANCISCO • New York • Chicago • Hibbing
Building for the Future—in a World of Industries



Yieldable Arches GIVE when the "squeeze" is on

Heavy or shifting ground around a mine opening always needs some form of support, to give the overburden a chance to settle naturally into a pressure arch. Mining men have found that the best type of support is one which will yield slowly to the pressures until the natural arch is formed; rigid sets simply cannot stand up under the squeeze of the dynamic forces.

HOLDS FAST UNDER NORMAL LOADS

Bethlehem's Yieldable Arch works on a principle of sliding joints, which are formed by the lapping of one U-shaped segmental steel section over another as shown in the illustration. Husky U-bolt clamps are installed in pairs over the lapped joints, and drawn up tightly enough to hold fast under normal loads. As pressures bear down, however, the arch yields, a little at a time.

PRESERVES MINE SAFETY

The more the Yieldable Arch "gives," the more the stress is transferred to the surrounding material. Eventually, equilibrium is reached and the Yieldable Arch stands pat, its structural integrity maintained and mine safety preserved. That is why you will hear it said that the yielding feature of the Arch is more important than its physical strength.

The Yieldable Arch can only be highlighted here, of course; there is much more you will want to know. Its ease of installation, for example, and its high degree of recoverability. You'll be interested too, in knowing, that many Yieldable Arch installations have paid for themselves in months! A Bethlehem engineer will gladly discuss the full story in terms of your own special problems. Just write to the address below.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Bechtel experience

helps produce . . .

MORE IRON ORE FOR CANADA

Canadian and U. S. steel mills soon will have another substantial source of high-grade iron ore as the result of a major ore beneficiation project initiated last year in the Wabush and Carol Lakes area, 200 miles north of the Seven Islands, in Labrador.

When completed in 1962, the beneficiation plant will have capacity to produce 7 million long tons of high-grade iron ore concentrates annually.

In addition to the concentration plant, for which Bechtel is furnishing design engineering and construction supervision after designing a pilot plant, the project involves construction of a town for 4,000 resident employees and their families, 40 miles of railroad, a modern airport and expanded shipping facilities at Seven Islands.

The Carol Project adds substantially to iron ore production in Northeastern Canada, which began 10 years ago at Knob Lake near the Quebec-Labrador border. First ore was shipped in 1954 and since that time a total of more than 50 million tons have been shipped to Canadian and U. S. mills.

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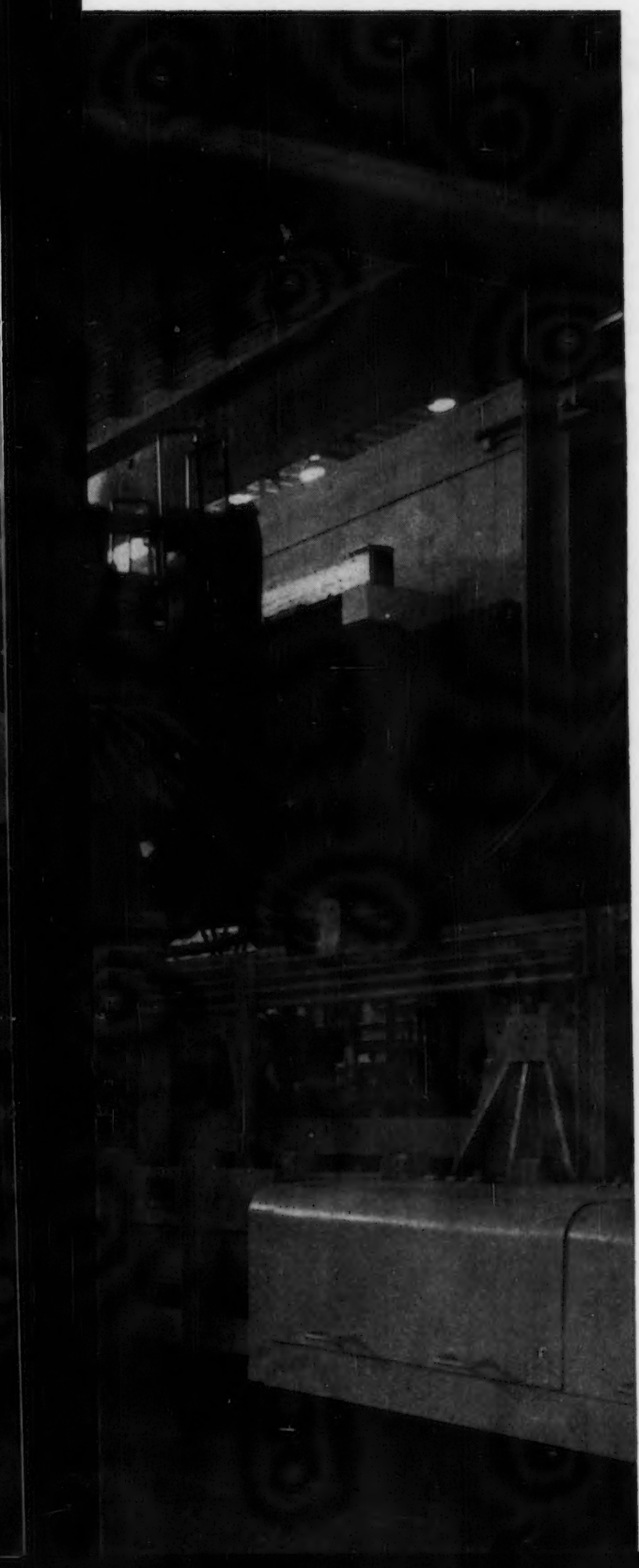
At Kennecott's new refinery... Twin Heroult Electric Furnaces designed

Copper cathodes are charged into the 13,500 KVA Heroult 90-ton electric arc furnace, one of two at Kennecott Refining's new plant south of Baltimore. American Bridge also fabricated and erected the plant's structural framework.

to keep 16,500-ton per month copper melt on schedule



Kennecott Refining Corporation's electrolytic copper refinery near Baltimore is the country's newest—a showplace of efficiency. One reason: a pair of 90-ton Heroult electric arc furnaces, each rated at 40 tons per hour.

Of nose-tilt design to facilitate launder pouring, they discharge a steady stream of molten copper (2150°) which is used in the horizontal casting of wire bars and the continuous casting of billets. One Heroult is on normal capacity operation while the other is a spare for use during relining, when the pre-heat furnace is down, or when additional production is required.

Copper cathodes are preheated to about 1400°F and door charged into the Heroult arc furnace on a peel arm crane. The three-phase power input utilizing ultra-high speed mechanical positioning for three 20″ electrodes with high-speed sensitive regulators maintains a constant arc above the copper bath for uniform temperature casting.

The two 90-ton Heroult arc furnaces can be tilted 40° forward and 15° backward. They feature mechanically positioned masts and special water-cooled skew-back roof rings that introduce water flow at the critical roof juncture to prevent warpage and burn out.

Whatever your arc-melt problem there is a Heroult electric arc furnace design for you. We've made them from 3 tons to over 200 tons capacity, for both swing roof top charge or door charge operation. They can accommodate induction stirring equipment, and can be designed for duplexing arrangements. And every Heroult is designed for maintenance by your own crew.

American Bridge has a complete electric furnace service that includes new installation, furnace modernization and part replacement. We'll be happy to quote on your building needs, too. Call our nearest office.

USS and Heroult are registered trademarks

American Bridge
Division of
United States Steel

USS

General Offices: 525 William Penn Place, Pittsburgh, Pa. Contracting Offices in New York, Philadelphia, Chicago, San Francisco, and other principal cities.
United States Steel Export Company, New York

This mark tells you a product is made of modern, dependable Steel.

Steel

sinkers

CP-69 Sinker Drill. This new, fast drilling, heavy-duty 55-pound class Sinker has "Beavertail" retainer for extra durability. All-purpose backhead permits Blower Dry, Wet and Air-Water operation. Air consumption and maintenance are low.

airlegs

Attachable or Integral Airleg Mountings set up fast! Give high drilling efficiency with hard-hitting CP Sinkers and tungsten-carbide bits. Closely held feed pressures insure full bit contact for maximum footage. Single or double telescopic feed available.

demos

The streamlined CP-124 Demo is the newest in a great line of smooth-handling demolition tools. Has shock-proof latch-type retainer and 4-bolt backhead. This all-new 80-lb. class demo packs more smashing power per pound than any other demo on the market.

core drills

CP post-mounted Core Drills cut costs for: blastholing, foundation sampling, grout-holing, weep holes. The new CP-65 Diamond Drill — world's fastest — delivers 20% more power than its predecessor, the world-famous CP-55. Capacity: 600 feet with EX Fittings.

Versatile skid-mounted Core Drills may also be truck mounted. Gasoline, diesel, air or electric drive. Capacity to 2,250 feet with EX Fittings.

Skid-mounted Core Drill

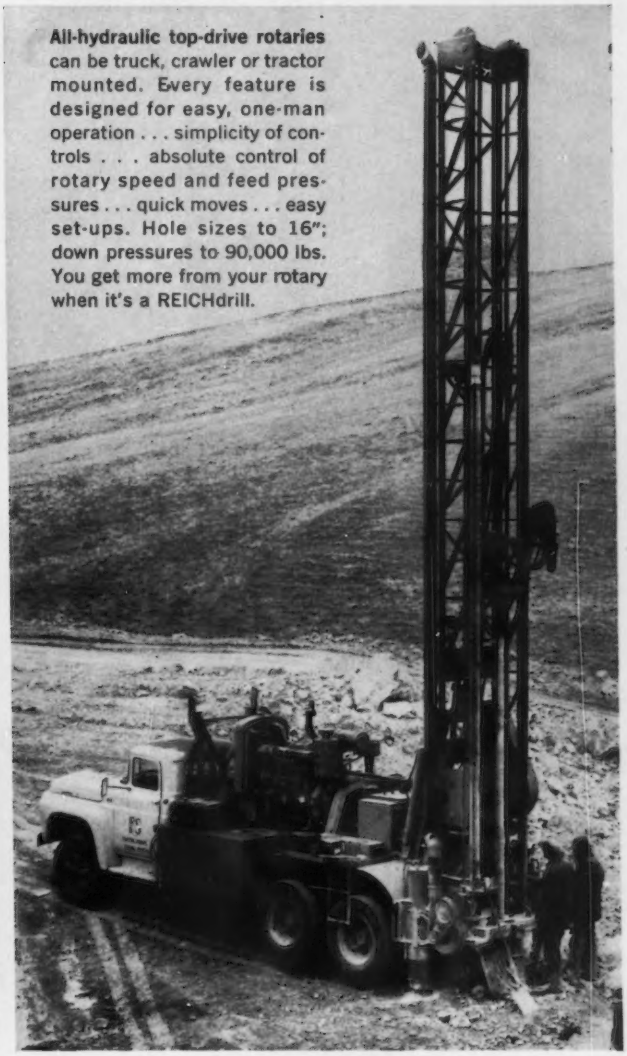
wherever there's a ROCK PROBLEM there's a CP ROCK DRILL TO LICK IT!

Tracdrils

All-new G-900 Tracdril for 4" and 4½" Deep-Hole Drills The only rig that can drill at right angles to tracks on either side . . . a full 180° swing. Drills extra-low snake holes or hard, high horizontals 11 feet overhead. Extra long tracks and knee action increase pulling power and stability. Automatic brakes and "dead man" tramming controls insure operator safety. Dual operating controls at boom end and turret save steps, increase throttle time.

REICHdrills

All-hydraulic top-drive rotaries can be truck, crawler or tractor mounted. Every feature is designed for easy, one-man operation . . . simplicity of controls . . . absolute control of rotary speed and feed pressures . . . quick moves . . . easy set-ups. Hole sizes to 16"; down pressures to 90,000 lbs. You get more from your rotary when it's a REICHdrill.



You'll find project-proved CP ROCK DRILLS setting footage records in every kind of formation. For EXPLORATION to see what you're up against . . . for BLAST HOLE DRILLING under every conceivable condition . . . for SECONDARY BREAKING or DEMOLITION – your quickest way to lick the problem is to start with the right equipment and the *right equipment* is CP.

To get up-to-date information on any specific Rock Drill shown here, write for the latest bulletin to: *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

AIR COMPRESSORS • PNEUMATIC AND ELECTRIC TOOLS • AIR-BLAST BITS • DIAMOND DRILLS • REICHdrills • ROCK DRILLS

NEW ROCK-LOADING TEAM BOOSTS PLANT PRODUCTION 25%

Hauler: *13-ton Michigan Tractor Wagon* Loader: *2¾ yd Michigan Tractor Shovel*
Output: *2,400 tons daily on 2 mile cycle*

Four years ago, the Fort Scott Hydraulic Cement Company, Fort Scott, Kansas, began a program to replace their four crawler-loaders and two 10-ton tandem-axle dump trucks with the most modern equipment available.

The program was completed when a 13-ton rear-dump Michigan Tractor Wagon went on the job a year ago. Its addition gave Fort Scott, one of the nation's three major natural cement producers, an all Michigan fleet. The Wagon teams with a 2¾ yd Model 175A Michigan Tractor Shovel in the rock pit. Three other 2¾ yd Michigan Tractor Shovels handle the crushed rock, coal, and clinkers in this 4,500 barrel-a-day natural cement plant.

Tractor Wagon hauls 120 tons per hour

It's the heavy rock loading and hauling operation that Mr. Pat Thomas, president of the 92-year-old firm, points to as being the best example of how the Michigan machines have improved job efficiency.

Shot Florentine limestone is currently being loaded out of the far end of a pit 90 feet wide and 5,000 to 6,000 feet long. This makes the average haul cycle, between pit and crusher, about two miles.

The 162 hp Tractor Wagon's stability and speed of up to 31 mph is a prime production factor in the mile long *uphill* run from pit to crusher. With torque converter and full power shift, power and speed are instantly adjusted to match the load demand.

On two 10-hour shifts, the Tractor Wagon, sideboarded to meet rated capacity, and the highly-maneuverable 2¾ yd Tractor Shovel will load out an average 2,400 tons of rock . . . rock which weighs, when loose, approximately 2,500 lbs per cu yd.

2 Michigans outwork 3 units formerly used

Production in the rock pit has risen 25% since the Tractor Shovel replaced a crawler rig with similar bucket capacity, and the Tractor Wagon took over the job formerly handled by two 10-ton dump trucks.

Upkeep "phenomenally small," says president

"With all five of the Michigans working constantly with heavy loads and over sharp rock and abrasive cinders, *we have spent less than $2100 on overhauls, parts, tires and labor during the past three years*," says Mr. Thomas. "I think this figure is extremely low considering what a machine goes through in a cement plant operation of this type. We've had virtually no downtime."

If you're hauling bulky materials off the highway, perhaps a Michigan Tractor Wagon could increase your production, too. When you pair it with one of the eight Michigan Tractor Shovel models (up to 6 cu yds), you've got a team that can't be beat. Let us demonstrate. Just call. There's no obligation, of course.

Michigan is a registered trademark of

CLARK EQUIPMENT COMPANY
Construction Machinery Division

CLARK® EQUIPMENT

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Benton Harbor 13, Michigan

In Canada:
Canadian Clark, Ltd.
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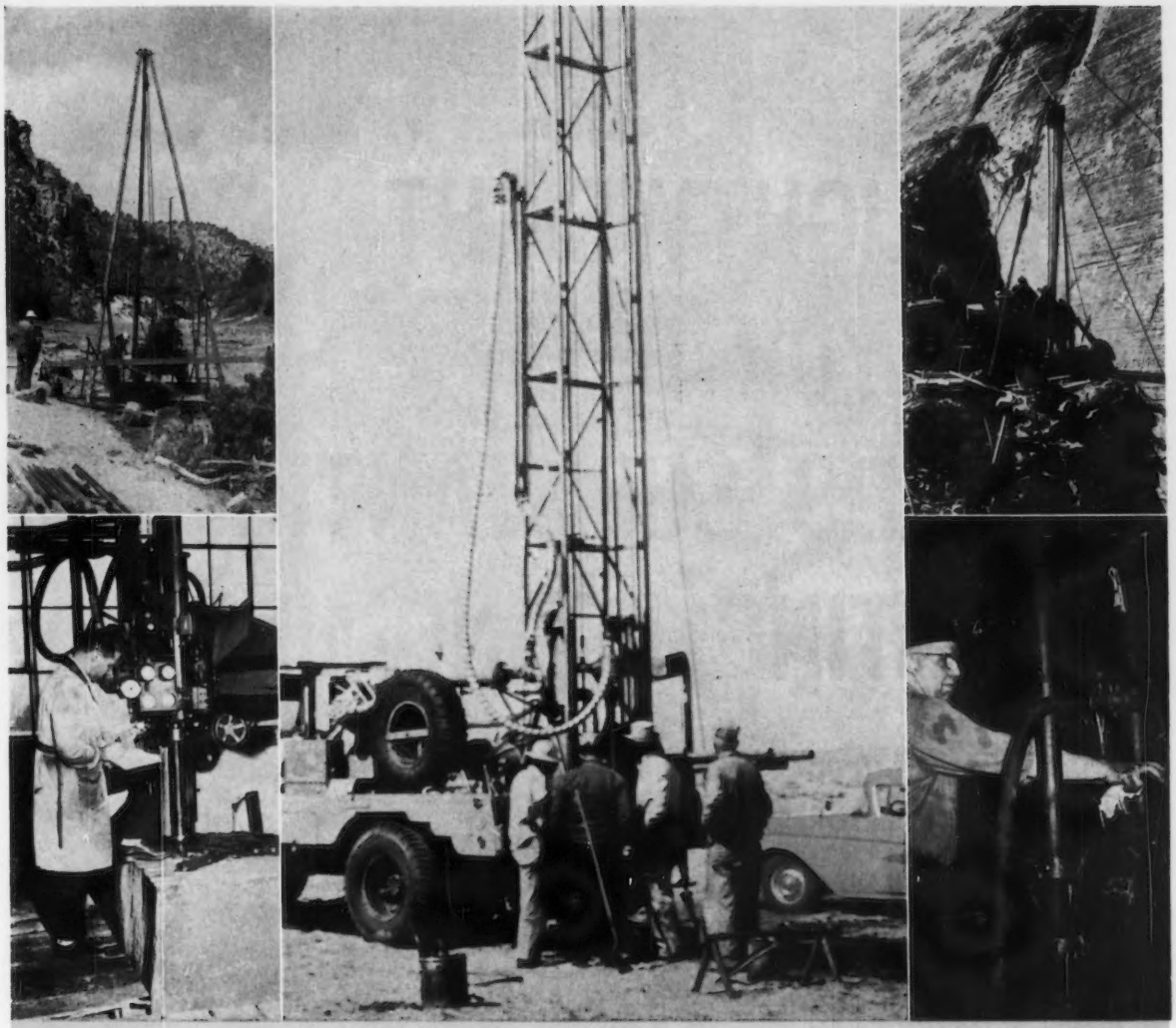


Operate at "Less cost per foot" . . .

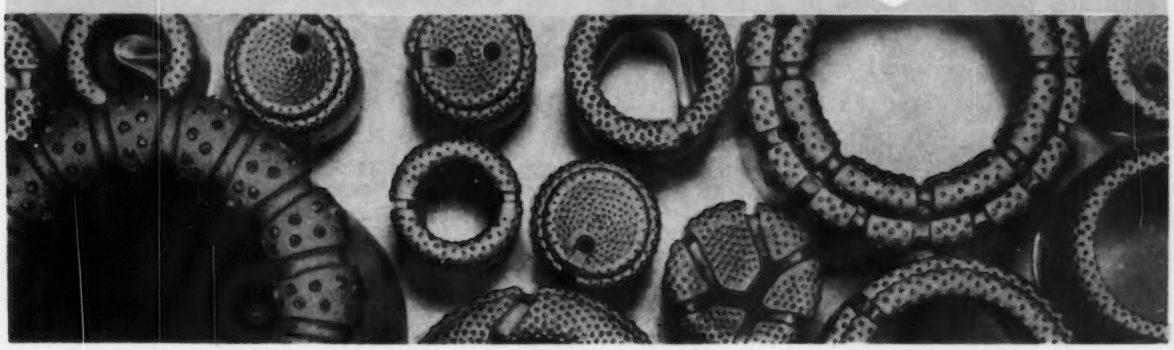
. . . with Christensen diamond bits and core barrels "engineered" for your particular drilling problem. Experienced field consultants are available regardless of your job location or scope of operations.

"Less cost per foot"

CHRISTENSEN DIAMOND PRODUCTS

MAIN OFFICE AND PLANT 1937 SOUTH 2nd WEST
SALT LAKE CITY, UTAH

SERVICE FROM WORLD-WIDE SALES OFFICES AND MANUFACTURING PLANTS



NEW LIGHTWEIGHT CONVEYOR BELT AFFORDS SUBSTANTIAL OPERATING ECONOMIES

RECENTLY INTRODUCED WOVEN CARCASS NEOPRENE BELT HAS ALREADY PROVEN ITS SUPERIORITY IN RUGGED UNDERGROUND MINING SERVICE

A new kind of conveyor belt, designed around a *revolutionary lightweight woven fabric carcass,* is proving itself in severe mining service.

Because of the strength and toughness of its interwoven carcass, the new belt has a long life expectancy. It's flexible . . . troughs and trains well . . . and does an excellent job of coal handling.

Top and bottom covers of Du Pont *neoprene* contribute to the belt's superiority. Neoprene provides needed *safety* because it is fire-resistant; will not support combustion. It gives improved *performance* because its high coefficient of friction eliminates power loss caused by slippage . . . reduces belt "run out" at loading points. Neoprene provides greater *economy* because its *balanced combination of properties* affords resistance to abrasion and impact; protects belt carcass from damage by acid mine water, mildew, and oil or grease sometimes present in mining operations.

Other advantages are cited for the new belt. For example, it's easier to handle and install, has longer wearing edges, holds splices and trains better. In addition, better flexibility and handling ease result in increased operating efficiency.

We'd be happy to tell you more about the dependability and long life of a neoprene belt. For more information on this radical improvement in belt construction—and sources of supply—write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. EMJ-11, Wilmington 98, Del.

DU PONT
REG. U. S. PAT. OFF.

NEOPRENE
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

entirely NEW ...ANOTHER TELSMITH SCREEN

For years Telsmith inclined screens—Pulsators and Vibro-Kings, for scalping and finishing—have proved their efficiency and low cost screening all over the world.

And now, the NEW TELSMITH HORIZONTAL SCREEN with

- **new space-saving compactness**
- **new thorough dewatering**
- **new sizing efficiency**
- **new high capacity**
- **new savings in operation and up-keep**
- **single, double, and triple deck; all sizes**

New FREE Book has pictures and all the details Ask for No. 291

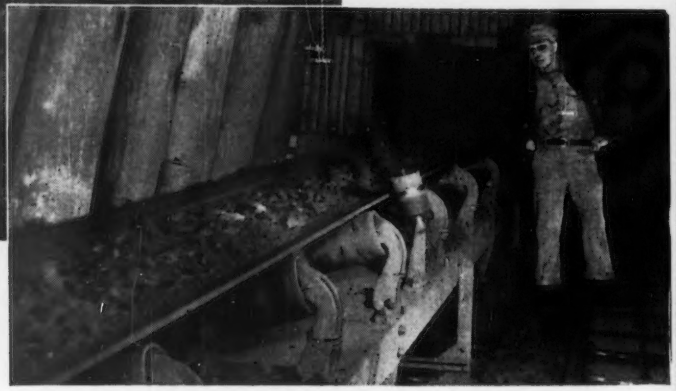
V-6-360

SMITH ENGINEERING WORKS
502 E. CAPITOL DRIVE, MILWAUKEE 1, WISCONSIN

DIVISION OF Barber-Greene

Cable Address: Sengworks, Milwaukee • Representatives in Principal Cities in all Parts of the World

40 STORIES *from Pit to Surface*



...IT'S R/M CONVEYOR BELT FOR LONG LIFTS!

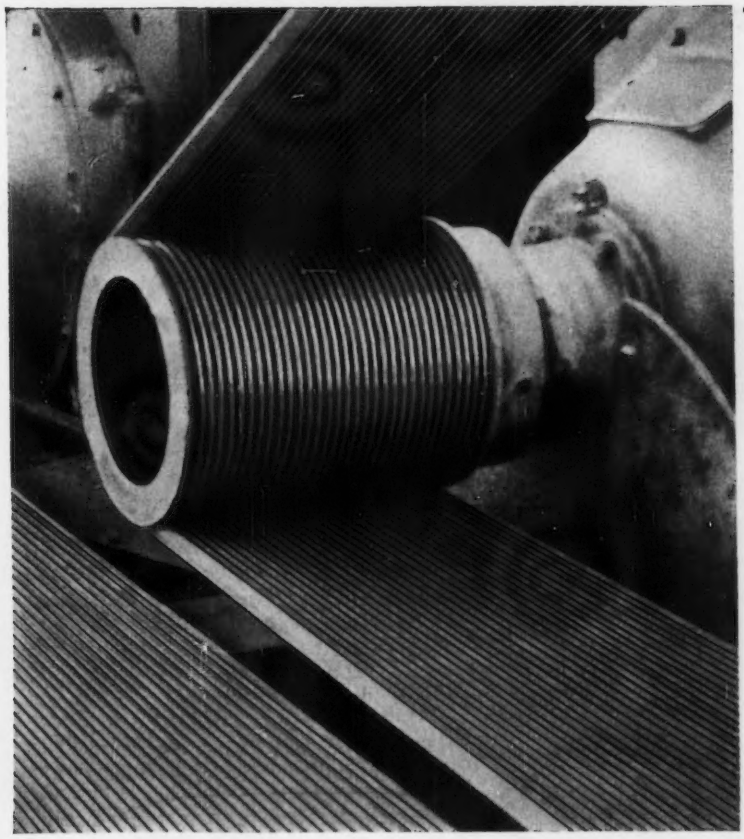
Easy troughability, flexibility, super-strength synthetic cords, high wear-resistance—make R/M Conveyor Belts ideal wherever long lifts at high tensions are required. The installation shown here, for example, was a quarter-mile conveyor with a lift from pit to surface loading station nearly as high as a 40 story building. An R/M conveyor belt made an exceptional record on this rugged haul. There's an R/M heavy duty conveyor belt for every materials handling requirement . . . each engineered to haul fuller, heavier loads—and *last longer*. With proper engineering, for example, you can increase hauling capacity up to 60% with Ray-Man Conveyor Belt and 45° idlers! Ask your R/M representative about other R/M Conveyor and elevator belts, about advantages of extra-flexible, double compensated, rip-resistant Ray-Man . . . about Homocord, the extra-cushioned belt for unusually abusive shock loading conditions, or about the Wedlok metal fastener splice which avoids vulcanizing splices. Any R/M Conveyor Belt with "XDC" cover means extraordinary resistance to wear and tear, longer life—"More Use per Dollar." Write for Bulletin M302 and Catalog CB25.

ENGINEERED RUBBER PRODUCTS ..."MORE USE PER DOLLAR"

RM1018

RAYBESTOS-MANHATTAN, INC.

MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

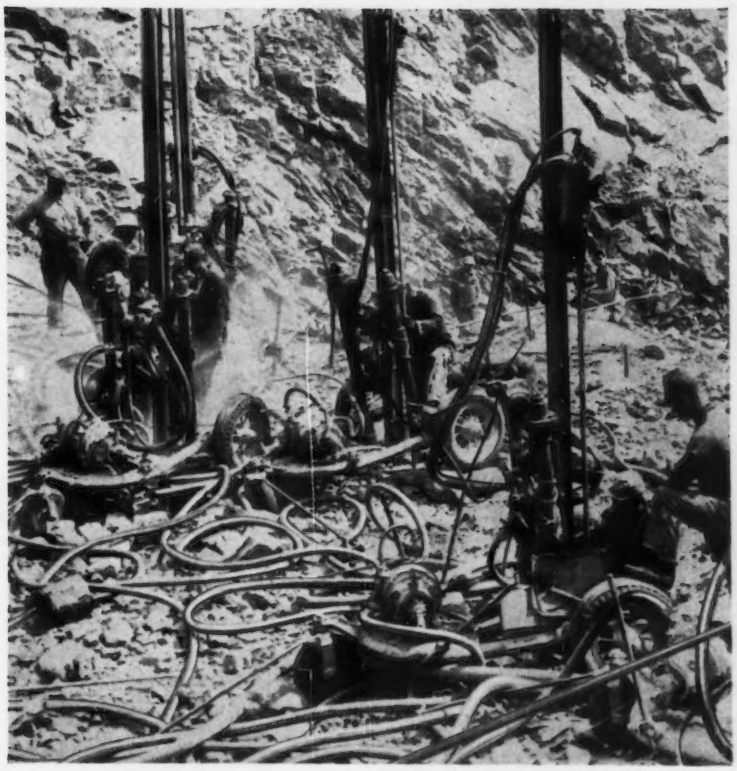


R/M POLY-V® DRIVE

More Power— in *Less* Space ... *with Reliability*

A *single unit* V-ribbed belt across full width of the drive-sheave—*not* an assembly of V-belts—enables patented Poly-V to deliver much *more* power in the same space as a V-drive . . . or *equal* power in much *less* space! Single unit belt design also eliminates belt "length matching" problems ... minimizes equipment down-time and belt replacement costs. Belt speed ratios remain constant from *no* load to *full* load to provide the smoothest running, coolest running—*longest wearing* drive you can install. Maintain groove shape. Just two sections of Poly-V Belt meet every heavy duty power transmission requirement. Write for Bulletin M141, or call your R/M Distributor.

CONVERT TO RM POLY-V and BE SURE!



HOMOFLEX HOSE *more flexible, weighs less than any hose for equal pressure*

- SUPER-STRONG
- PRECISION BUILT
- NO PRE-SET TWIST—WILL NOT KINK
- INSEPARABLE TUBE-TO-COVER BOND
- UNIFORM INSIDE AND OUTSIDE DIAMETERS
- EASIER, SAFER COUPLING

Strong, lightweight, and "flexible as a rope"—Homoflex is the easiest handling hose and lasts longer. Made in types for air, water, other fluids and gases. Ask about other types of R/M rubber hose for your job applications. Write for Bulletins M620 and M694.

ask the man in the cab

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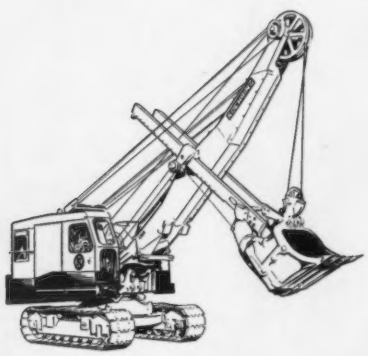

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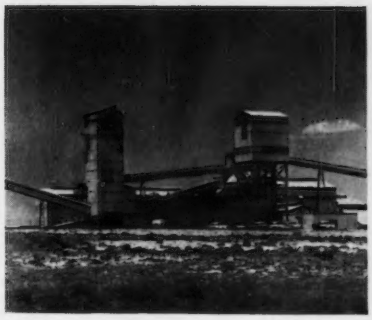

Ropes on Koepe Hoist Handle 2,400,000 Tons in Potash Mine in New Mexico

Serving for 26 months on a Koepe skip hoist at National Potash Company's mine, Carlsbad, New Mexico, Bethlehem Wire Rope handled approximately 2,400,000 tons of corrosive ore. The hoist cables were 1-in. 6 x 27 Form-Set Purple Strand, with fiber core; 1⅜-in. 19 x 19 Form-Set mild plow, non-rotating rope was used for the tail lines.

Economical service is something you can rely on when you specify Bethlehem Wire Rope. Put it to work and you can count on faithful rope performance, shift after shift.

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There's a distributor of Bethlehem Rope near you, supplied by our nationwide network of wire rope mill depots.

Foxboro pH Dynalog Recorder has an input impedance of 80,000 megohms — eliminates the need for intermediate amplification. Span is adjustable from 2-12 pH; zero, from 0-12 pH.

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BLASTING IS OUT— D9 AND RIPPER IN— PRODUCTION UP 35%

Gillen Coal Mining, Inc., is salvaging a six-ft.-thick seam of coal near Carbondale, Pa. To get to the coal, 180 ft. of overburden must be removed—10 ft. of topsoil, 100 ft. of hardpan and, finally, 70 ft. of rock.

Gillen used to blast through. Then they changed to a Caterpillar D9 Series E Tractor with a No. 9 Ripper. Production shot up 35%. Cost savings are estimated to be *60%!*

The overburden, rough as it is to work with, is the kind of material the D9 and No. 9 Ripper eat up. Working in 50-ft. passes, the team fragments the hardpan (average cu. yd. weight 3200 lb.) into right-size pieces for two Cat DW21s. They're moving up to 4000 yd. a seven-hour shift. When needed, the D9 pushloads the scrapers and 'dozes, too.

The D9 and No. 9 is an all-business combination of power and speed. The Series E Model D9 has a 335 HP (flywheel) turbocharged engine to put massive power into the work. You get more power from every gallon of fuel. The Series E D9 has a heavier undercarriage. Track components are bigger, heavier. You get up to 40% more life with deeper hardened steel shoes, links and rollers. A new equalizer bar makes the Series E D9 even more stable.

New power shift transmission gives you the flexibility and anti-stall features of a torque converter with the split-second snap of direct drive. Finger-tip control gives operators instant changes under full load without clutching.

Match this with the No. 9 Ripper to break your way through production bottlenecks. For the right tractor-ripper combination, see your Caterpillar Dealer, who will prove his recommendation with a demonstration.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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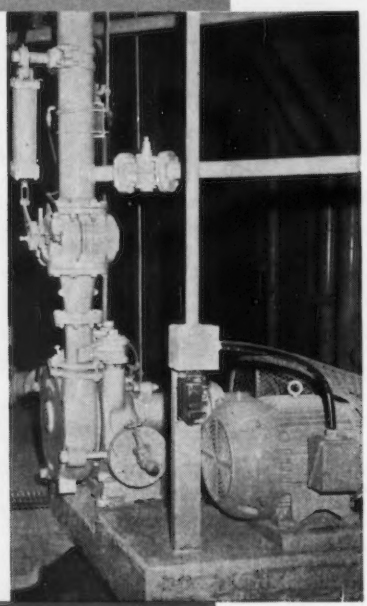

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ENGINEERING AND MINING JOURNAL

NOVEMBER, 1960

We're Still Talking to Ourselves Too Much

IT'S UNFORTUNATE that the wealth of useful information and constructive opinion presented at the recent Mining Congress Meeting in Las Vegas, Nev., and the AIME Rocky Mountains Minerals Conference in Salt Lake City could not be shared more liberally with the public. Despite the volume of press releases available on some of the talks, publicity in the national press fizzles out with the conclusion of the meetings—and yet the problems of the mining industry which require sympathetic public understanding go on unceasingly.

Restrictive state tax policies and extreme conservational attitudes stand in the way of mineral development in some areas. In Michigan, Minnesota, Alabama and elsewhere they have been responsible for driving capital for exploration and mine development out of the area, in fact completely out of the country.

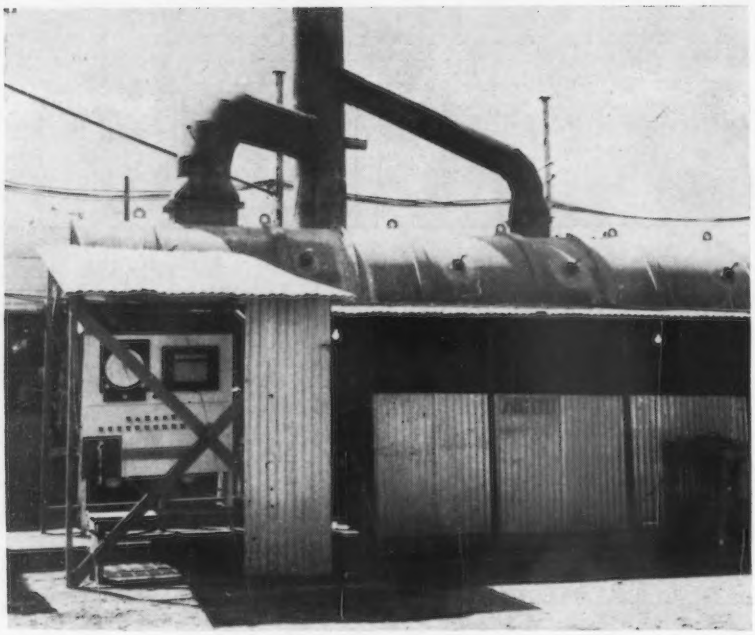
Speaking on "The State of the Iron Ore Industry," C. F. Beukema, president of Oliver Iron Mining Div., U.S. Steel Corp., told the AMC that "in our greatest ore producing state, Minnesota, the business climate —the tax climate—is a matter of paramount concern to the iron mining industry. There is local reluctance to recognize that the high-fixed investment costs required by new technologies require public assurance of equitable taxes. Currently the tax base in Minnesota depends heavily on so-called "natural ores" through (1) an ad valorem tax on unmined 'ore' reserves presumed to have future value, and (2) high occupation or severance taxes applicable to production. Despite the progressive depletion of this tax base, there is no governmental or general public recognition of the necessity to wean state and local government activities from the support of this previously lucrative source of revenue. You may find it hard to understand the fact that in 1960 Oliver Iron Mining Div. of U.S. Steel Corp. paid the largest Minnesota ad valorem tax in its history, on the least ore reserve in its history, at a time when the remaining reserves as they occur were of limited and even questionable marketable value. Furthur sobering thought is provoked when I tell you that for many years, Oliver Iron Mining Div. has paid more money in occupation taxes alone in Minnesota than would U.S. Steel Corp. as a whole have paid had all of its profit, wherever generated, been taxed at the prevailing Minnesota income tax rate applicable to industry other than iron mining."

Beukema said "While any objective study of Minnesota taconite development will find the technology well advanced, I am sure that such a study will also show the prospective investors in future sources of iron ore in Minnesota have not yet found, nor have they been offered, definitive assurances that the tax burdens of the past will not be shifted increasingly to taconite investments as the natural ore source is depleted."

Obviously, the crippling impact which excessive taxation will have on the future of Minnesota's economy needs to be made clear to the Minnesota public, and to the people of other areas as well.

In a similar manner the public needs to be convinced that so-called "wilderness legislation" is completely out of tune with modern industrial civilization. If we want to decimate our population and go back to 18th century existence, then by all means let's have wilderness legislation. A few hundred thousand Indians had the entire wilderness of the U.S. to themselves a few centuries ago and often starved to death in the environment. Ever since, we have been fighting our way out of the wilderness and owe the prosperity and comforts we now enjoy to the development of industrialization. Only a small percent of the total land area needs to be mined to provide metals and minerals for modern society. But the public doesn't know this, and it's our job in the mining industry to tell the public our side of the story convincingly.

Aside from technical papers which are of major interest to a mining audience, perhaps we ought to send more of our convention speakers to talk to public audiences, and conversely to invite more non-mining men to debate with us on labor, land laws, tax policies etc. at future mining meetings. Perhaps this new approach will get us and the public off of dead center on certain issues of vital concern to the future of mining.



HEART OF THE PROCESS is the 54-in. x 42-ft rotary calciner. Fourteen gas fired burners keep combustion zone temperatures in 1,400-1,500°F range.

Arizona Copper Silicates Respond to Segregation

GEORGE A. FREEMAN is manager of operations; has office in Casa Grande.

GENERAL VIEW of segregation plant. Shed holds fine-ore, coke and salt bins.

THE FIRST COMMERCIAL PLANT in the United States using the segregation process for treating silicate and mixed silicate-sulphide copper ores was recently placed in operation at Transarizona Resources' property south of Casa Grande, Ariz.

The company mines a copper silicate (chrysocolla) ore, averaging 2% copper, from an open pit developed on their mineral holdings — three patented claims in the Lake Shore group, a section of ground adjoining the Papago Indian Reservation, and 22 additional claims known as the Drake group.

Transarizona, controlled by Transcontinental Resources Ltd., a Canadian exploration and development company, is 28 miles south of Casa Grande, the nearest supply and rail center. Both electric power and natural gas for calcining the crushed, screened, and mixed plant feed are available at the plant site. Mining operation in the shallow pit follows standard practice: primary blastholes are drilled with a Gardner-Denver wagon drill and drill rods are fitted with detachable 3½-in. T-C bits.

Broken ore is loaded into 8-ton trucks by a Michigan loader with a 2-yd scoop for subsequent transfer to the processing plant. Blastholes for ammonium nitrate and Primacord are drilled on 6-ft centers to a depth that will give a 12-ft bench. The trucks dump their load onto the elevated stockpile area near the rail grizzly covering a 45-ton ore storage hopper.

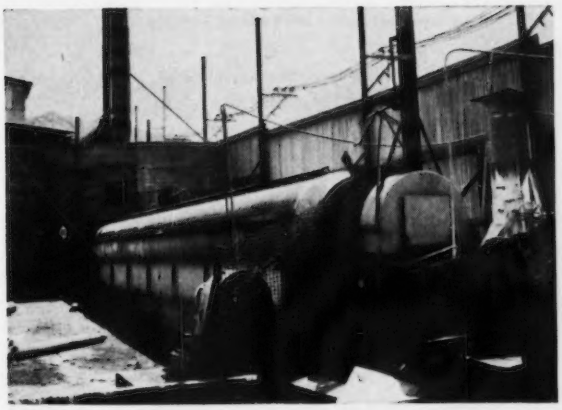
Process Not New

In the processing plant, minus 10-mesh ore is heated at 1400°F to 1500°F with sodium chloride and coke (or other carbonaceous materials). This segregation process produces fine metallic copper, which can be recovered by conventional flotation methods.

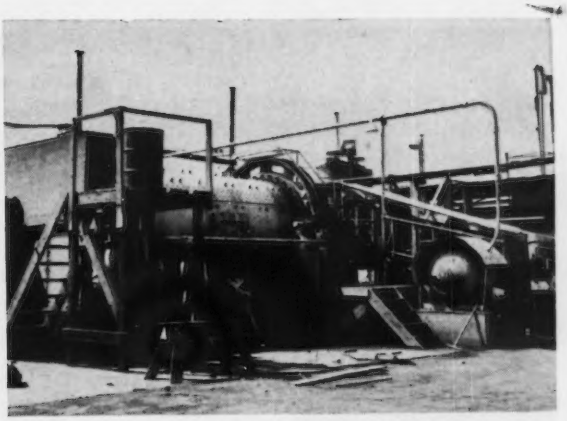
The USBM and Transarizona Resources ran extensive bench and pilot plant tests but the segregation process is not new. It was developed and patented in the '20s by Mineral Separations Ltd., who, at that time, tried it in Africa. The company built a plant in Southern Rhodesia and Union Miniere du Haut Katanga built one in the Congo. The plants were successful, producing copper concentrates with better than 85% recovery. They were closed after short runs due to a variety of reasons (mechanical problems, economies), but mainly to the low copper price in the depression period.

Transarizona's processing plant is made up of a crushing and screening plant to reduce pit ore to 10-mesh calciner feed; fine-ore storage and mixing units; calcining and cooling unit; ball mill-classifier circuit to reduce cooled calcines to 65 mesh; xanthate flotation; and filter unit.

Pit ore is fed onto the rail grizzly, spaced 12 in. at a rate of 15 to 20 tph. Reduction to 10-mesh calciner feed is done in three stages, the equipment available for this operation consisting of a primary jaw crusher, set 2 in.; vibrating screen with ½-in. openings; secondary cone crusher, set 3/8 in.; 10-mesh vibrating screen; and a 36-in. rolls unit, taking the 10-mesh vibrating screen oversize and operating in closed circuit with the secondary cone crusher.



HEATED PRODUCT from rotary calciner is cooled to 200°F while passing through a 4 x 44-ft Baker type rotary cooler.



BALL MILL-RAKE CLASSIFIER grinds calcines to 65 mesh. Overflow is then treated in 8-cell rougher flotation machine.

The finished 10-mesh material is belt-conveyed from the screen to a 400-ton fine-ore bin at the head of the rotary calciner. Here also are situated two 3-ton storage bins, one for salt and the other for coke. Both materials are added in predetermined quantities, ahead of a Weightometer unit, to the ore stream. Belt conveyor and bucket elevator transport the mixture to a 12-ton surge bin. From here, the mixture is fed at a set rate to the rotary calciner.

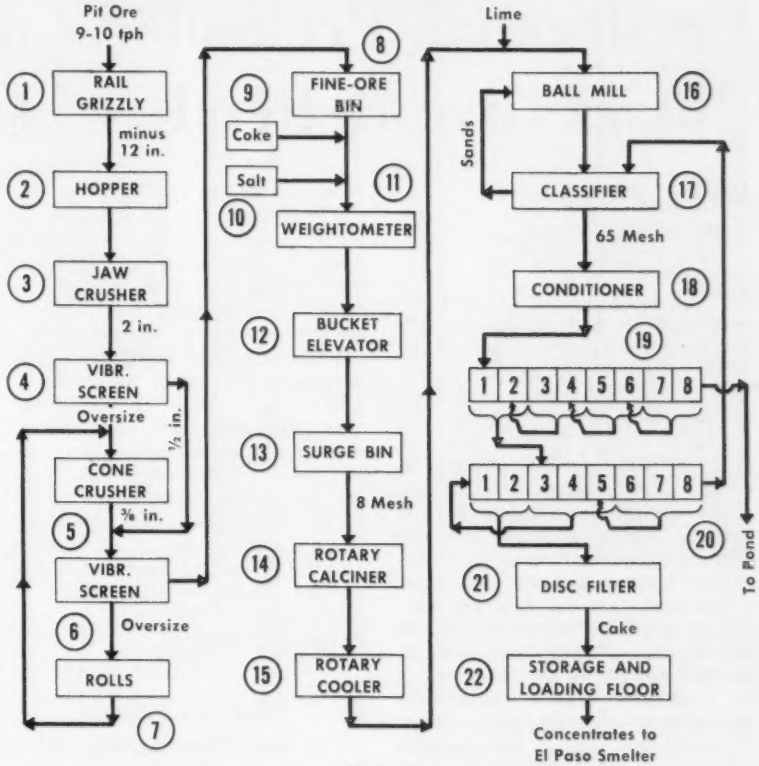
Calciner Is the Key

The rotary calciner is the heart of the process and is 54 in. in dia and 42 ft long. Firing is indirect by 14 burners using natural gas. Temperature in the combustion zone is held at from 1,400°F to 1,500°F. Optimum results depend on proper temperature control. Discharge calcines are cooled to about 200°F while passing through a 4x44-ft. Baker-type rotary cooler preparatory to treatment in a ball mill-rake classifier circuit.

The circuit grinds the cooled calcines to 65 mesh. The classifier overflow is conditioned and then treated in an 8-cell rougher flotation machine. Froth produced by the first two cells goes to an 8-cell cleaner machine, and the tails are pumped to the tailing pond. Concentrates produced by the first two cells of the cleaner machine are pumped to a 6-ft, 3-leaf disc filter. Cake produced by the filter falls by gravity onto a concrete storage and loading floor below.

Reagent setup is relatively simple. Lime is used for pH control; xanthates for collector; and alcohol for frother. Final concentrates assay from 45% to 50% metallic copper. They are trucked to Casa Grande for shipment to the Asarco smelter at El Paso, Texas.

Transarizona Segregation Plant



LEGEND

1. Rail grizzly, spaced 12 in.
2. 45-ton hopper
3. 24x18-in. jaw crusher set 2 in.
4. Vibrating screen with ½-in. openings
5. 3-ft Symons cone crushers set ⅜ in.
6. A-C vibrating screen with 10-mesh deck—5x10 ft
7. 36-in. rolls
8. 400-ton fine-ore bin
9. 3-ton coke bin
10. 3-ton salt bin
11. Weightometer
12. Bucket elevator
13. 12-ton surge bin
14. 15-in. by 42-ft Standard Steel Co. rotary calciner
15. 4x44-ft Baker type rotary cooler
16. 6x12-ft ball mill
17. Rake classifier
18. 5x6-ft conditioner
19. Rougher flotation machine made up of 8 Denver 48-in. cells
20. Cleaner flotation machine made up of 8 Denver 36-in. cells
21. Eimco 6-ft, 6-leaf disc filter
22. Concrete storage and loading floor

FIG. 1 The top and core of pillars constructed from precast rings are filled with concrete. The final 6 to 8 in. are filled with grout placed in an adjustable form as shown above.

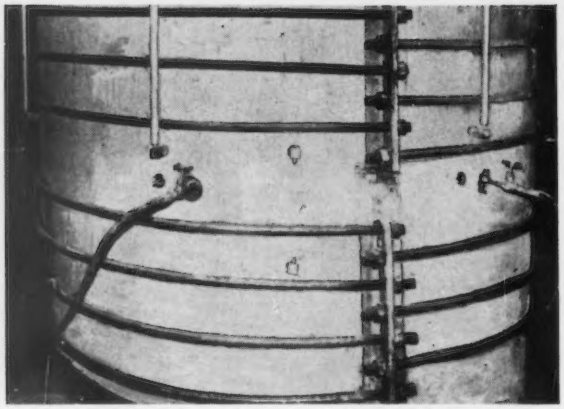


FIG. 2 Pillars are prestressed with banding anchored with double angle iron. Measuring points (center) are above and below the incipient crack at the level of the jacks.

Prestressed, Preloaded Concrete Pillars Give Better Roof Control

JOHN J. REED

C. DAVID MANN

ST. JOSEPH LEAD CO. PRELOADS and prestresses permanent concrete pillars to prevent roof settlement and caving when replacing rock pillars.

Flat jacks are injected with high-pressure water to raise the pillar high enough to assume much of the roof load, and the water is replaced with grout. External tension bands are placed around the pillar to prevent buckling. The successful system also depends on the systematic placement of roof bolts around the pillar area.

The work described here has been a joint effort of the mine research and mine operating departments of St. Joseph Lead Co. to develop stronger, more effective concrete pillars for underground mine support.

During the past 30 yrs, concrete pillars up to 12 ft in dia by 50 ft high have been built occasionally, where needed in the Southeast Missouri lead mines. In at least two instances, such pillars were built with the object of 100% recovery of high-grade ore pillars; but generally, and certainly with present costs, these pillars are used only to safeguard important installations. Past experience, substantiated by 20 yrs of compression measurements on pillars built in 1938, has shown that concrete pillars which are not preloaded will never carry appreciable weight by natural loading until the roof rock and adjacent rock pillars are already failing. By that time it is too late; the roof caves away from the pillar, and the pillar stands visible for a time in the rock pile, intact but useless.

In early attempts at preloading, some 16 screw jacks were placed atop the pillars, and tightened against the roof. However, their total force was only of the same order as the weight of the pillar itself, about 80 psi on the pillar area. A much more powerful preloading force was clearly required. Thesis work in mining at the University of California, and subsequent knowledge of the use of flat jacks in France, led to the solution.

How the Pillars Are Constructed

Until recently, all pillars were built entirely of concrete poured in place and heavily reinforced with ordinary internal reinforcing rods. Sizes ranged from 8 to 12 ft in dia and from 20 to 50 ft high. Since 1955, through considerations of support distribution, and to provide a more convenient size pillar to build, a 6-ft dia has been adopted. A 35-ft pillar is the highest of this size built to date.

In a further effort at convenience and cost cutting, precast rings have been tried. These are 1 ft high, with a 2-ft hole through the center, and a 3-in. step on top and in the bottom, so that they key together as stacked. With existing equipment, the rings can be stacked within about 4 ft of the roof, after which the core and top portion are filled with concrete mixed on site. The final 6 to 8 in. is later tamped full of dry-pack grout (Fig. 1). These rings contain only light mesh reinforcing, to permit their handling during transit and stacking.

This article describes the construction of 10 pillars in all. The first seven were built of pre-cast rings, while the last three were poured in place in daily lifts of 4 ft. The concrete in the precast rings was fairly well controlled at a specified 3,000-psi strength. Quality control on site-mixed concrete was introduced after building the fourth pillar, and raised the over-all strength of concrete obtained from 500 to over 6,000 psi. The precast rings have rough upper surfaces, and therefore fit together poorly.

The first four pillars were stacked with nothing between the rings, and the joints in the fourth were grouted after stacking. The joints in pillars 5, 6, and 7 were mortared during stacking. In all of these pillars, several rings failed by flexure under preloading, and it was finally concluded that there was no practical way to develop the full potential strength of a pillar built of precast rings. Thereafter, pillars 8, 9, and 10 were built of high-quality concrete, placed on site, with no interior reinforcing, but

Dr. Reed is professor of mining engineering, Colorado School of Mines, Golden, Colo. He was formerly head mine research engineer, St. Joseph Lead Co., Bonne Terre, Mo. Mr. Mann is mine research engineer for the company.

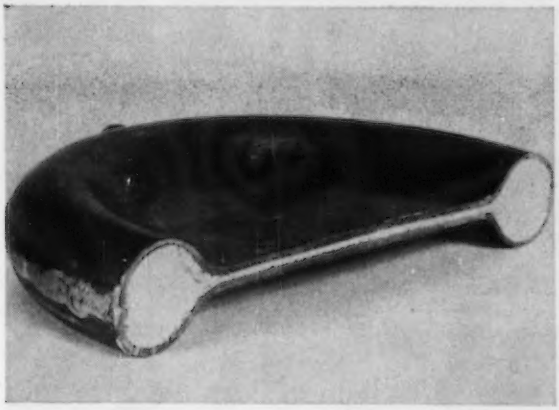


FIG. 3 Flat jacks (cross-section filled with cement above) are injected with water at high pressure to raise the column. Water is then replaced by grout through a transfer cylinder.

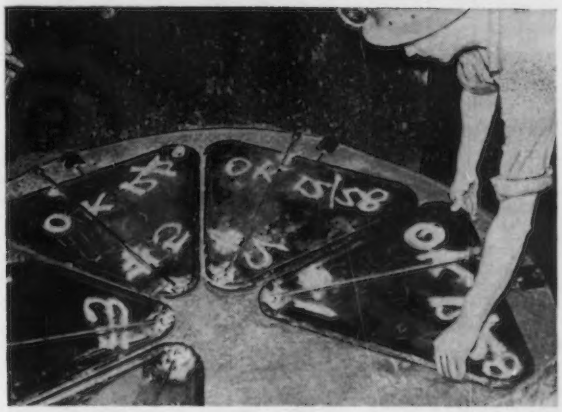


FIG. 4 The flat jacks are embedded near the base of the pillar. Rubber washers, which can be pried out later, provide countersinks for the two fittings on each of the jacks.

FIG. 5 Reinforcing grids (½-in. bars on 3-in. centers) are placed 2 in. above and below the flat jacks for stress distribution. Effective area of the six jacks is 61% of the total.

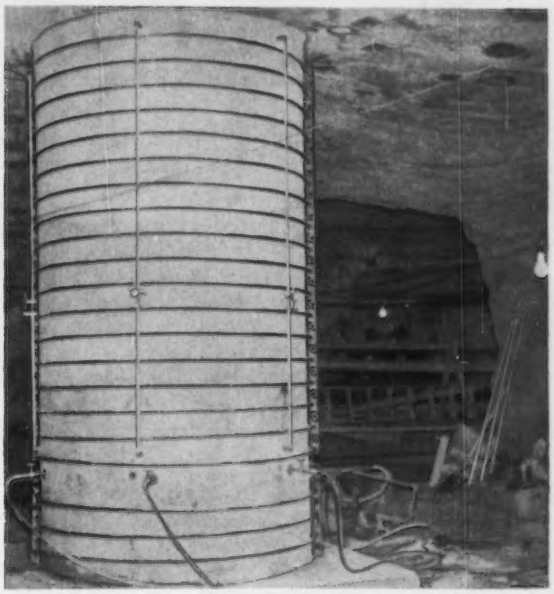


FIG. 6 When pillar is cured and prestressed by banding, it is prepared for preloading. Three external measurements are made, two on the pillar and one between floor and roof.

externally prestressed with 1-in. round mild steel bands on 6-in. centers. Two pairs of heavy 3-in. angles, welded back to back, provided anchorage for these half-circle bands. These angles were drilled on 3-in. centers, and placed on opposite sides of the pillar (Fig. 2). Eventually, ⅞-in. high-strength bands will be used, with standard tank lugs. The bands are tightened to refusal with a heavy impact wrench.

How the Pillars Are Preloaded

Preloading is accomplished with a system of six triangular flat jacks imbedded in the base of the pillars as shown in Figs. 3 and 4. The manufacture and use of these jacks has been highly developed in France by the Freyssinet Co., represented in the U.S. by Intercontinental Equipment Co. Inc. of New York.

Grids of ½-in. reinforcing bars on 3-in. centers, shown in Fig. 5, are placed 2 in. above and below the jacks for stress distribution. Countersinks for the two fittings on each jack are provided by covering them with heavy rubber washers (Fig. 4), which can be pried out later. The total area of a 6-ft pillar is 4,070 sq in., and the effective area of the six jacks is 2,481 sq in., or about 61% of the total.

When the pillar is cured and prestressed by banding, it is prepared for preloading. Certain instrumentation is essential during this procedure to control and evaluate the loading. In addition to an accurate hydraulic pressure gage on the pumps, three external measurements are used. Six dial-gage extensometers are attached to the pillar, one above the center of each jack, as shown in Fig. 6. These measurements give an accurate unit compression within the pillar, and warn of eccentric loading. From these data, the Young's Modulus is derived.

A second set of points straddles the position of the jacks (Fig. 2), and permits measurement of the gap, or jack opening, by an inside micrometer, as shown in Fig. 7. This measurement is used to calculate the apparent Young's Modulus of the pillar as a whole. It includes not only the effect of any slack within the pillar, but also that of any openings in the rock layers of the roof or floor.

A third set of measurements is made with a movable dial-gage exten-

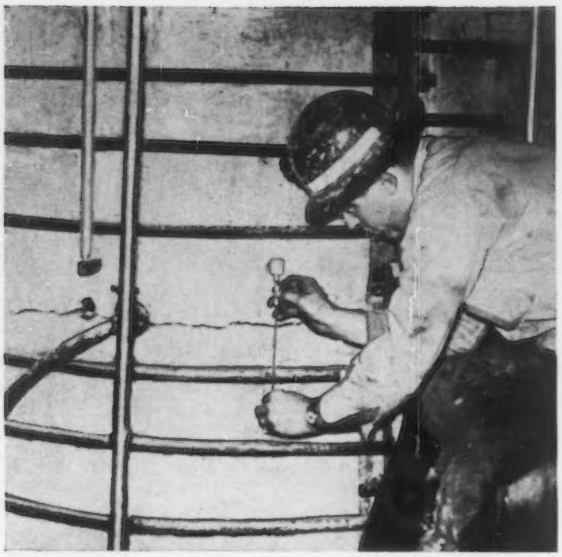


FIG. 7 With preloading well advanced, a precise measurement of the jack opening is used to calculate Young's Modulus.

FIG. 8 Boiler test-pumps are used for preloading. Left—manifold control console; foreground—Jiffy grout mixer.

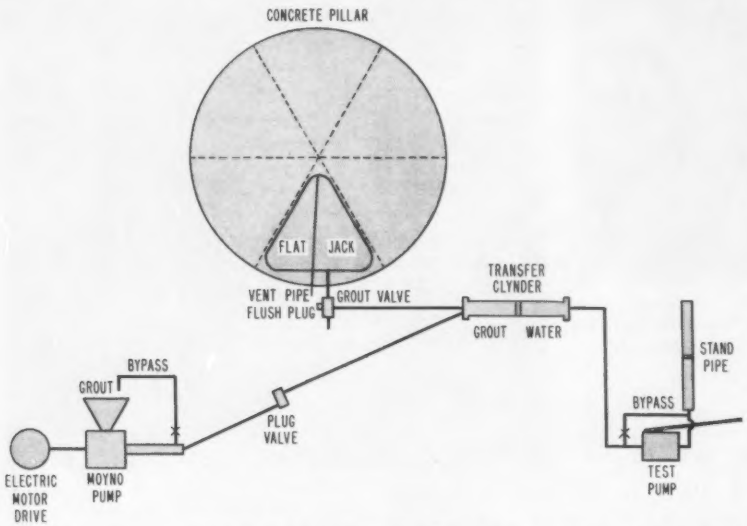


FIG. 9 Transfer of grout to the flat jacks is effected by a transfer cylinder, which also boosts the Moyno pump pressure.

Table I Grouting Procedure for Flat Jacks

1. Vent pipe, grout valve, and plug valve open.

2. Test-pump bypass and Moyno bypass closed.

3. Transfer cylinder piston near grout end.

4. Pump grout with Moyno until all water is flushed from jack and thick grout exits from vent.

5. Open Moyno bypass, plug vent pipe, open test-pump bypass, close Moyno bypass, fill transfer cylinder with grout (water level rises in standpipe), close plug valve, open Moyno bypass and flush Moyno.

6. Close test-pump bypass and pressurize jack to final pressure with test-pump (water level falls in standpipe).

7. Close grout valve.

8. Open grout valve flush plug and plug valve.

9. Flush system with water through Moyno pump.

10. Disconnect grout valve.

someter between sets of permanent convergence stations in the roof and floor of the mine opening, or stope.[4] These measurements detect local stope divergence during preloading due to closure of open roof and floor layers or elastic deformation, and perhaps subsequent long-term reconvergence due to general closure of the stope.

Actual loading of the pillars is done with water, by manifolding the six jacks to hand-operated boiler test-pumps (Fig. 8). Generally, a good tight pillar will pick up the load evenly; but sometimes one or more of the jacks take most of the load, as detected by the extensometers. When this occurs, these jacks are cut out of the system periodically, in an attempt to overinflate the rest of the jacks and avoid too much eccentricity in the loading.

The jack pressures are manipulated through a console table (Fig. 8), equipped with a blackboard to record pressures and corresponding extensometer readings. When the desired preload condition is attained with water pressure, the next step is to replace the water with grout, one jack at a time, to render the condition permanent. While one jack is being grouted, the other five hold the load.

A small Moyno pump handles the grout at pressures up to about 100 psi, and high final pressures, with low volumes involved, are produced by means of a transfer cylinder, indicated in the schematic diagram, Fig. 9. This cylinder has a 2-in. bore and 30-in. stroke. A free piston separates water supplied by the test-pumps from grout supplied by the Moyno pump.

Table II Summary of Results on Preloaded Concrete Mine Pillars

Pillar	Height, base to roof	Avg. grout press., psi	Total load, tons	Avg. concrete stress, psi	Avg. strength of concrete poured on site, psi*	Avg. strength of dry pack top, psi	Avg. jack opening, in.	No. jacks ruptured	Apparent Young's Modulus, based on jack opening, E, psi	Young's Modulus, based on compression within pillar, E, psi	Avg. local stope divergence		
											No. of stations	Avg. divergence, in.	Avg. distance from pillar, ft
1	18'6"	700	840	425	.....	3,542	.049	0	1,710,000	1,600,000	6	0.0007	2.70
2	14'0"	1,080	1,300	660	507	4,996	.227	0	489,000	2,170,000	6	0.0191	3.25
3	12'9"	1,250	1,500	765	778	4,960	.366	1	320,000	552,000	6	0.0167	4.88
4	17'5"	2,400	2,880	1,470	566	.....	.262	0	1,170,000	3,790,000	4	0.0025	12.52
5	28'0"	1,600	1,920	980	5,164	.....	.280	1	1,180,000	2,850,000	too high for extensometer		
6	27'0"	1,600	1,990	980	4,764	4,140	.309	0	1,030,000	1,940,000	too high for extensometer		
7	27'7"	1,750	2,180	1,070	3,710	3,180	.263	0	1,350,000	1,340,000	too high for extensometer		
8	8'3"	3,300	4,100	2,020	5,108	4,170	.286	3	700,000	5,570,000	4	0.112	1.24
											4	0.013	4.84
9	14'2"	3,666	4,550	2,240	5,177	4,770	.281	2	1,350,000	5,760,000	4	0.096	1.31
10	11'6"	3,150	3,910	1,920	6,417+	3,920	.332	3	798,000	6,260,000	4	0.069	1.22
											4	0.012	4.87

Remarks: Pillars 1-7 built of precast rings.
Pillars 8-10 built monolithically of site-mixed concrete.
Pillars 1-4—Concrete placed pneumatically, slump perhaps 10 inches.
5-10—Concrete hoisted and shoveled into place, slump 2-4 inches.
Mix = 1:1.75:2.65; Max. aggregate 1 inch.
Corresponds to 7.3 bag/yd.^{3}

Pillars 1-7—From 2 to 8 rings failed by flexure and crushing.
Pillars 8-10—No signs of failure. Loading discontinued due to limitations of preloading system.
*Based on 28-day tests of 6x12-in. cylinders. 2 of 8 cylinders from pillar 10 exceeded 7,070 psi, capacity of testing machine.

The position of the piston in the transfer cylinder is indicated by the water level in a vertical plastic standpipe, shown feeding the test-pumps in Fig. 8. A simple plug valve separates the cylinder from the Moyno pump under high pressures, and a special grout valve makes the connection to the flat jacks.

This grout valve was invented especially for the job, and is a key factor in the successful application of the system. It makes possible the absolutely leakproof seal of the flat jacks with a standard pipe plug under conditions of extreme pressure. The only expendable parts are a simple coupling on the jack, plus the pipe plug. Table I is the step-by-step procedure for grouting the jacks.

When all six jacks have been grouted, there remains an open crack, visible in Fig. 7, which covers 39% of the pillar area between and around the jacks. This crack is caulked with mortar or oakum and wedges, and subsequently grouted solid. For long-term permanence, the finished pillar should be gunited to prevent the banding from rusting.

Results Are Summarized

The results obtained in building and preloading the 10 pillars discussed are summarized in Table II. As will be shown later, to fulfill its purpose, an artificial mine pillar must be: (1) preloaded to a high proportion of its ultimate strength; (2) as strong as economically possible; and (3) highly resistant to shortening; i.e. pillar should have a high Young's Modulus.

The superiority of pillars 8-10 in meeting these requirements is strikingly apparent from the tabulation. By testing full-size pillars to failure, this work has discovered and emphasized the weaknesses, inherent and otherwise, in the pillars being built. This is certainly vital in trying to build truly strong, effective pillars as cheaply as possible.

Column 9, Table II, refers to the number of jacks ruptured in each pillar. Rupture seems to be associated with excessive jack openings, as well as with high pressures.

Theoretically, these jacks have a "run" of 1 in., and actually, one jack in pillar 3 opened ¾ in. Jacks have been repeatedly proof-tested in the laboratory at about 7,000 psi, supported only over their flat central portion. Under these conditions, the edge weld is under uniform tension.

Although unsubstantiated to date, it is postulated that, in contrast, a jack imbedded in concrete has its outer roll partially supported during inflation, and the edge weld is subject to additional flexure stresses as it tries to push out into the open crack. These flexure stresses, added to the uniform tension, probably cause local concentrations high enough to initiate failure, and the weld rips open.

Whatever the mechanics of these ruptures may be, where too-great dilation is expected, the simplest solution seems to be to use two sets of flat jacks in the pillar, one above the other. In this way, the first set of jacks pressurized would give only moderate preloading, but would take up nearly all the slack, creep, etc. in pillar, roof, and floor. The second set of jacks should then attain a very high preload with very little dilation.

How Strength Calculations Prove Preloading Effective

A study of the properties of the rock and concrete pillars involved in the area described here will emphasize the importance of preloading any structure used for permanent underground support. These considerations do not necessarily apply to such temporary, yielding supports as timber or yieldable props or arches. They are based on actual conditions and measurements in the area.

Rock properties:

Young's Modulus, E, = 5.5 x 10^6 psi
Compressive strength = 30,000 psi
Overburden = 475 ft
Wt = 182 lb/ft^3
Therefore, pressure = 1.26 psi per ft of depth
Normal original vertical stress at mine level = 475 ft x 1.26 psi/ft = 600 psi.
At 90% extraction, in a stope of semi-infinite extent, normal pillar stress should become 600 x 10 = 6,000 psi.

Concrete Properties:

Young's Modulus, E, = 5.5 x 10^6 psi
Compressive strength = ±5,000 psi

Pillars 2 through 7 have an average ht of 248 in. In preloading these pillars, an average jack opening of 0.284 in. was required to develop an average load of 988 psi in the concrete pillars. If the pillars had not

been preloaded, to develop this loading naturally would require the adjoining rock pillars to be shortened an equal amount. The fundamental relationship between stress, modulus, and strain is

$$\text{stress} = \text{modulus} \times \text{strain}.$$

In this case, the *additional* load necessary to shorten the rock pillars by 0.284 in. would be:

$$\text{Stress} = 5.5 \times 10^6 \times \frac{0.284}{248}$$
$$= 6{,}300 \text{ psi}.$$

Therefore, by the time natural ground movement developed only 988 psi in the concrete pillars, the stress on the rock pillars would have had to increase from 6,900 to 12,300 psi, or 105%.

Moduli Are Compared

From the results of preloading 10 pillars, it is apparent that there is always some slack or separation in the roof and floor rocks. However, for the sake of illustration, let us assume there is no slack anywhere, and consider only the relative moduli of the concrete and rock pillars. The Modulus, E, measured between points on concrete pillars 4 through 7, averaged 2,480,000 psi. When the stress in such pillars reaches 1,000 psi,

$$\text{strain} = \frac{\text{stress}}{\text{modulus}} = \frac{1{,}000}{2{,}480{,}000} =$$
$$403 \times 10^{-6} \text{ in./in.}$$

If this strain is caused by natural loading, then it must also occur in the adjacent rock pillars. This means raising their stress by

$$\text{stress} = 5.5 \times 10^6 \times 403 \times 10^{-6} =$$
$$2{,}200 \text{ psi}$$

to a total of 8,220 psi.

Actually, pillar 8 was an excellent pillar with a modulus of 5.57 x 10 psi, but because of openings in the roof, the flat jacks had to open 0.286 in. before the pillar carried its final load of 2,020 psi. Therefore, under natural loading, the adjacent rock pillars would have had to take an additional unit strain of

$$\text{strain} = \frac{0.286 \text{ in.}}{99 \text{ in.}} = 0.00289 \text{ in./in.},$$

in order that the concrete pillar carry 2,020 psi. This means the stress in the rock pillars would increase by

$$\text{stress} = 5.5 \times 10^6 \times 2{,}890 \times 10^{-6} =$$
$$15{,}900 \text{ psi},$$

and their total stress would increase from 6,000 to 21,900 psi, or 265%.

Because of separations in the roof layers, pillar 8 had to be raised almost ⅛ in. before it carried any appreciable load at all. Of the total jack opening of 0.286 in. at a concrete stress of 2,020 psi, an opening of 0.227 in. existed at a stress of only 1,080 psi. To have reached even this low load level without preloading, the rock pillars would have had their stresses increased from 6,000 to 18,600 psi, an increase of 210%.

From these calculations, based on actual measurements, it is clear that the stresses on the rock pillars in the area studied would have had to increase by 105% to 265% before the concrete pillars could carry their present loads, if the latter had not been preloaded. Obviously, a rock pillar already beginning to fail cannot be expected to carry such increased loads without collapsing completely. On the contrary, the effect of time alone will cause its ultimate failure under a constant load. Furthermore, stope convergence of this magnitude will generally cause roof failures that will render the area unworkable.

In order to distribute the concentrated load on the roof directly over a preloaded pillar, and to prevent possible local spalling, it is advisable to bolt the roof over and around the pillar location in a close pattern. When the area is completely bolted, the bolts should be retightened repeatedly, to eliminate all possible slack in the roof before the pillar is completed. Any slack eliminated in this way will leave that much more "run" in the flat jacks available for actual preloading. The roof was bolted around pillars 8 through 10, but the bolts were tightened only once as installed. After preloading these pillars, many of the bolts were obviously loose, and all had to be retightened.

Preload Calculations

No final conclusion has been reached as to how much preload should be placed on pillars such as those described. Studies by the U.S. Bureau of Reclamation[5] indicate that concrete will support about 70% of its ultimate load for an indefinite time. They also indicate that both 18x36-in. and 36x72-in. cylinders will develop about 85% of the compressive strength of 6x12-in. cylinders of the same concrete.

In addition to these factors, one should consider the coefficient of variation of the compressive strengths of the 6x12-in. test cylinders. This coefficient increases as concrete quality control decreases. It is equal to the standard deviation of the test cylinders divided by their average strengths. The standard deviation of the cylinders from pillar 10 is 892 psi. Therefore, the coefficient of variation for this pillar is:

$$\text{Coefficient of variation} = \frac{892}{6{,}417} \times 100$$
$$= 13.9\%.$$

The criteria generally accepted by the Bureau require that the strength of 80% of the test cylinders exceed the design strength. Using this convention, with the Bureau's cumulative probability curves, and a coefficient of variation of 13.9%, one finds that the design strength should be 88% of the average cylinder strength, to assure that 80% of the cylinders test above the design strength.

If all the factors developed above are now applied to the average compressive strength of concrete in pillar 10, the result should be the safe permanent load this pillar can carry without reinforcing, with no factor of safety.

Thus:

$$70\% \times 85\% \times 88\% = 52.5\%;$$
$$6{,}417 \text{ psi} \times 52.5\% = 3{,}360 \text{ psi}.$$

Preloading Prevents Failure

The design philosophy for underground structures should of necessity be very different from that used on the usual civil engineering structure. It is obvious from theoretical considerations, and has been amply shown by precise measurements, that no mine support structure can carry load unless either it is purposely preloaded, or the mine structure deforms in some way to cause load to be transferred to the support structure.

It is also obvious that all truly elastic deformation of the mine structure is complete as soon as the opening is made, and before any supports can be installed. Therefore, any subsequent deformation of the mine structure is, in reality, incipient failure; and the structure will get progressively weaker with time. Under these conditions, it is apparent that underground support structures should (1) be placed as soon as possible, (2) be pre-loaded almost to their yield point, and (3) be designed with little factor of safety other than their yield range itself.

For example:

1. A roof bolt with a minimum yield point of about 21,500 lb and a minimum breaking strength of 32,500 lb should be placed with an initial tension of about 16,000 lb. Thus it will offer a maximum of reinforcing effect to the undiminished strength of the rock, rather than requiring the rock to begin failing before the bolt works to capacity. So placed, the bolt still actually has a safety factor of two, provided by its yield range.

In contrast, if the bolt is placed at a low initial tension, and the rock begins to fail, there is no reason to believe it will ever stop failing, and the bolt will eventually fail also in

spite of its high factor of safety. Stated another way, the really important factor is the safety of the entire composite structure, not of the individual bolt.

2. Prestressed, preloaded concrete pillars should be loaded close to their yield strength, because this will reduce the critical load in the adjacent rock structure and prevent its continued failure. The safety factor of the concrete pillar is the yield range of its prestressed steel banding.

To date, no properly built pillar has been loaded to failure, so the actual reinforcing effect of the prestressed bands is not known. It is believed that by placing two sets of flat jacks in each pillar, one above the other, the first set can eliminate the slack in the structure, and the second will attain pressures up to 5,000 psi, which will amount to pillar stresses of over 3,000 psi. If this causes no signs of failure, the amount of prestressed banding might well be reduced.

Conclusions

Analysis of data collected during the construction, testing, and preloading of 10 large prestressed concrete mine pillars leads to the following conclusions:

1. Roof over and around the pillar should be pattern-bolted, and bolts should be retightened several times to eliminate all possible slack, before building pillar.

2. Pillar should be built monolithically of high-grade concrete, and prestressed with external banding.

3. A second set of flat jacks should permit high ultimate loading, after the first set eliminates excess structural slack.

4. Pillars should have highest possible modulus of elasticity for maximum effectiveness.

5. Actual stope divergence of appreciable magnitude can be obtained by preloaded pillars. Thus the miner can at last take an active, as opposed to a passive, role in ground support. The stope conditions can now be improved, rather than simply maintained. For the first time, to the authors' knowledge, there is a controllable force available for ground support that approaches in magnitude the forces that must be withstood.

Acknowledgments

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* Now general mine superintendent.

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Alumina From Anorthosite—A Report From California

ONE OF THE CURRENT cooperative research projects jointly sponsored by the California Div. of Mines and the U.S. Bureau of Mines involves an attempt to develop a commercial process for extraction of alumina from anorthosite.

According to a report in the Mineral Information Service, magazine of this California division, early tests have shown that an alumina recovery of 90% is possible with the lime-soda sinter process.

The lime-soda sinter process for recovering alumina from aluminum silicates involves mixing ore with enough limestone and soda ash so that upon sintering the mixture, a dicalcium silicate and sodium aluminate will be formed. The sodium aluminate is soluble, while the dicalcium silicate is insoluble, in causticized solutions. After separating leach liquor from insoluble residue, alumina may be recovered by precipitation.

In practice, the process is more complicated, and additional operational steps and techniques are necessary. Here's basically how the process works:

All of the components—anorthosite, limestone, and soda ash—must be ground to achieve good mixing. Components must be mixed in such ratio that the final sinter will carry a mol ratio of CaO to SiO_2 of about 2.0, and a mol ratio of Na_20 to $A1_20_3$ of about 1.0. Some means of control to assure uniform sintering is desirable.

The mixture may then be sintered in a rotary kiln, in the same manner used to prepare cement clinkers. However, up-draft sintering on a traveling grate appears to promise a better job than does the rotary kiln. The sinter is ground to about 100 mesh, and mixed with leach liquor in a ratio of about ½ g per ml. An optimum leach liquor should be composed of about equal equivalents of NaOH and Na_2CO_3, and the total Na_2O content should be about 50 g/l. This composition is subject to wide variations in practice.

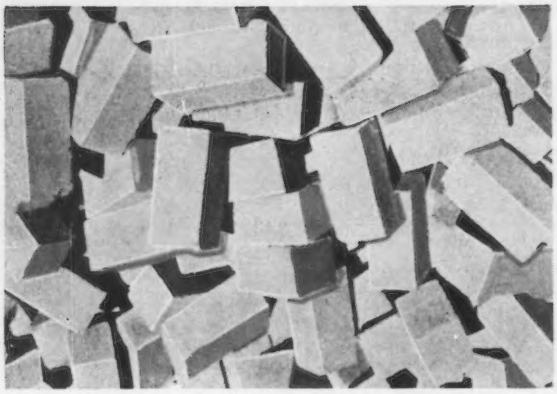
Best leaching temperature is about 70° C, and ½ hr contact time is generally enough. Immediate separation of liquor is desirable. Serious troubles can occur at this point, because poorly made sinters tend to gel or set. Because the lime-soda sinter composition is not far removed from the area in a ternary system representing Portland cement compositions, such characteristics should be expected where leach slurries gel on standing. To minimize such occurrences, sintering techniques must be controlled carefully.

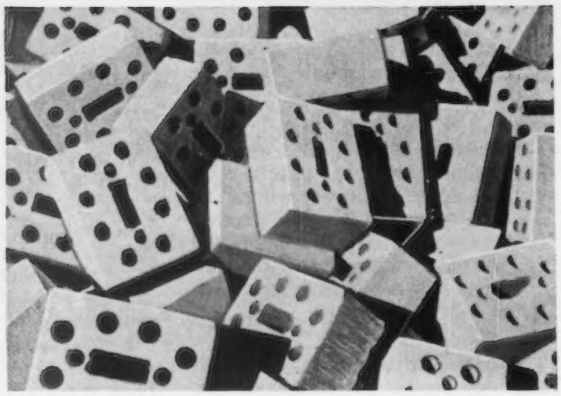
Leaching also takes a small amount of silica into solution. The pregnant leach liquors will carry about 3 g of SiO_2 per l. This silica must be removed before precipitating the alumina, for alumina specifications generally require that the SiO_2 content be less than 0.03%. The SiO_2 is removed from the leach liquor by adding about 6 g per l of lime, and autoclaving for one hour at 200 psi. This treatment drops the SiO_2 content of the liquor to less than 0.1 g/l.

Alumina is precipitated from the purified leach liquor by treating the liquors with a gas mixture of CO_2 and air. In a commercial setup, the gas mixture would be flue gases from a furnace operation in the plant. Alumina recovered is pure alumina trihydrate. Calcining the trihydrate gives the alpha alumina of commerce.

Analysis of a one-ton sample of anorthosite taken by the Div. of Mines from the San Gabriel Mountains showed the following makeup:

$A1_20_3$	27.8%	K_2O	0.29%
SiO_2	52.6%	MgO	.40%
CaO	9.5%	TiO_2	.25%
Fe_2O_3	1.9%	L.O.I.	
Na_2O	5.8%	1000C	.72%





NORMAL-SIZED standard bricks, left, and narrow-sized holed bricks, right, are two types that Auguste Victoria brick plant produces. Broad research program developed steam-hardening process used to consolidate waste-product particles into brick.

ATTRACTIVE miners' apartments are faced with bricks made from Auguste Victoria flotation tailings and filtered flyash.

Germans Succeed In Making Building Stones from Mill Tailings & Flyash

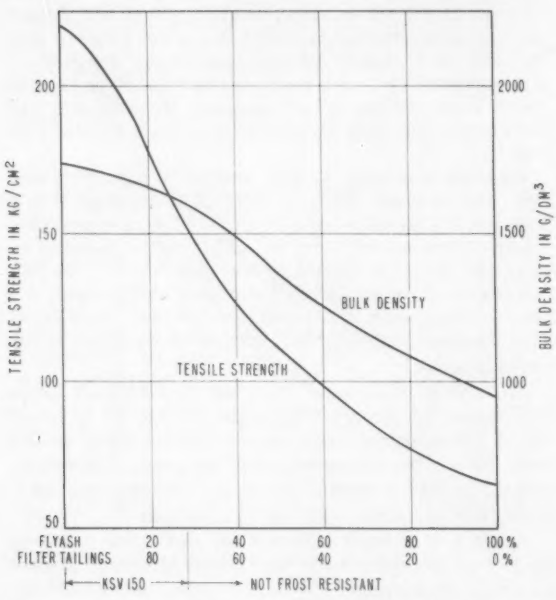


FIG. 1. Tensile strength and bulk density of filter-tailings—fly-ash limestone sand bricks. Binder: calcium carbide.

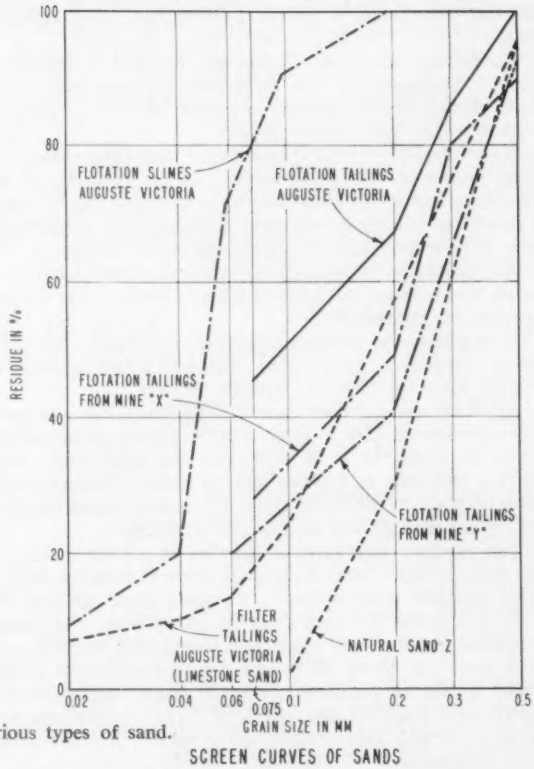


FIG. 2. Screen analysis curves of various types of sand.

Table I — Chemical Analysis of Additives

	% SiO_2	% Al_2O_3	% Fe_2O_3	% CaO
Natural sand				
Auguste Victoria	85–93	1.5–5.5	0.9–2	0.5–1.2
Filter sands				
Auguste Victoria.....	75–90	0.5–8	3–4	0.9–1.4
Slimes				
Auguste Victoria.....	65–70	9–12.5	6.5–8.3	0.9–1.3
Puzzuolana.....	52–60	9–21	5–12	2–10
Calcareous tufa.....	49–59	10–19	4–12	1.8
Melting chamber slag.	45–60	—	—	—
Flyash.....	30–50	17–30	5–15	1.5–8
Blast furnace slag.....	28–40	5–17	0–3	29–48
Brown coal filter slag..	1–3	3–6	12–17	40–55

Table II — Limestone Sand Brick Sizes DIN 106

Type	Sizes mm	Tensile strength kg/cm²	Gross weights kg/dm³
Limestone hard bricks	240x115x71	250	—
Limestone solid bricks:			
Thin size (DF)	240x115x52	150	1.8
Normal size (NF)	240x115x71	150	1.8
1½ NF/2DF	240x115x113	150 u. 100	1.8
2¼ NF/3DF	240x175x113	150 u. 100	1.8
Limestone holed bricks:			
1½ NF/2DF	240x115x113	150 u. 75	1.4
1½ NF/2DF	240x115x113	75 u. 50	1.2
2¼ NF/3DF	240x175x113	150 u. 75	1.4
2¼ NF/3DF	240x175x113	75 u. 50	1.2
Limestone hollow block bricks:			
6¾ NF	370x175x238	50 u. 25	1.2
9 NF	370x240x238	25	1.2
9 NF	370x240x238	50 u. 25	1.0
Limestone light bricks, porous solid bricks:			
4½ NF	365x240x113	50 u. 25	<1.0
6¾ NF	365x240x175	50 u. 25	<1.0
9 NF	365x240x240	50 u. 25	<1.0

JOHN B. HUTTL

UTILIZING— putting to useful work— the waste products of mine, mill, smelter and power plant, by making useful building stones and bricks from them, is a problem given impetus by Germany's intense rebuilding effort after World War II. Such materials include slags from iron and steel works, mill tailings, flue dusts and flyash from large coal-fired power plants.

Experiments conducted in the early 1940's had not been encouraging. Research carried out by Professor Grün in 1941 on using filter tailings as an additive in masonry mortar proved disappointing; for even when mixed with Rheinsand, the resulting mortar had low tensile strength. Conventional flotation tailings behaved the same.

Soon after the war, however, the subject was again investigated. This article describes the success of one company in producing acceptable building bricks from tailings and flyash. This information was extracted from a comprehensive report by Dr.-Ing. Erich Tanner published in ERZ-METALL, January 1960.

Extensive research during the period 1948-50 showed that flyash and flotation tailings could be used to produce steam-hardened building products. In the process that was evolved, the pressed or cast building blocks or forms, made up of additives containing silicic acid—sands, for example—and lime as a binder, are consolidated by treatment with superheated saturated steam. This "steam hardening" comes about through the formation of calcium hydrosilicate from silica and lime in superheated saturated steam. Results are most satisfactory when the additives have a high SiO_2 content and the sand has a large specific surface (it is very fine).

A chemical analysis of natural sand and some waste materials is given in Table 1. The SiO_2, Al_2O_3, Fe_2O_3 and CaO values shown are ideally suited for the steam hardening process.

Tests in 1948 on flyash and flotation tailings, at the Gewerkschaft Auguste Victoria at Marl in Westfalen, confirmed the above findings; and a large brick factory was then built. This company operates several large coal mines, a coking plant, power plants and a lead-zinc mine with a 1,000-tpd flotation concentrator. Waste material used in the brick factory consists of tailings from the concentrator and flyash from the coal-fired power plants.

Tailings Give Advantages

Grain composition and grain structure of the flotation tailings are found to be more uniform than those of natural sands. Reactivity of the broken grain is stronger than that of unbroken natural sands; and because a large amount of fines is available in the tailings, the grinding costs incurred when using conventional additives are saved. Also, grain sizes best suited for specific types of pressed bricks and production processes can be obtained by subjecting flotation tailings to a sand-slime separation.

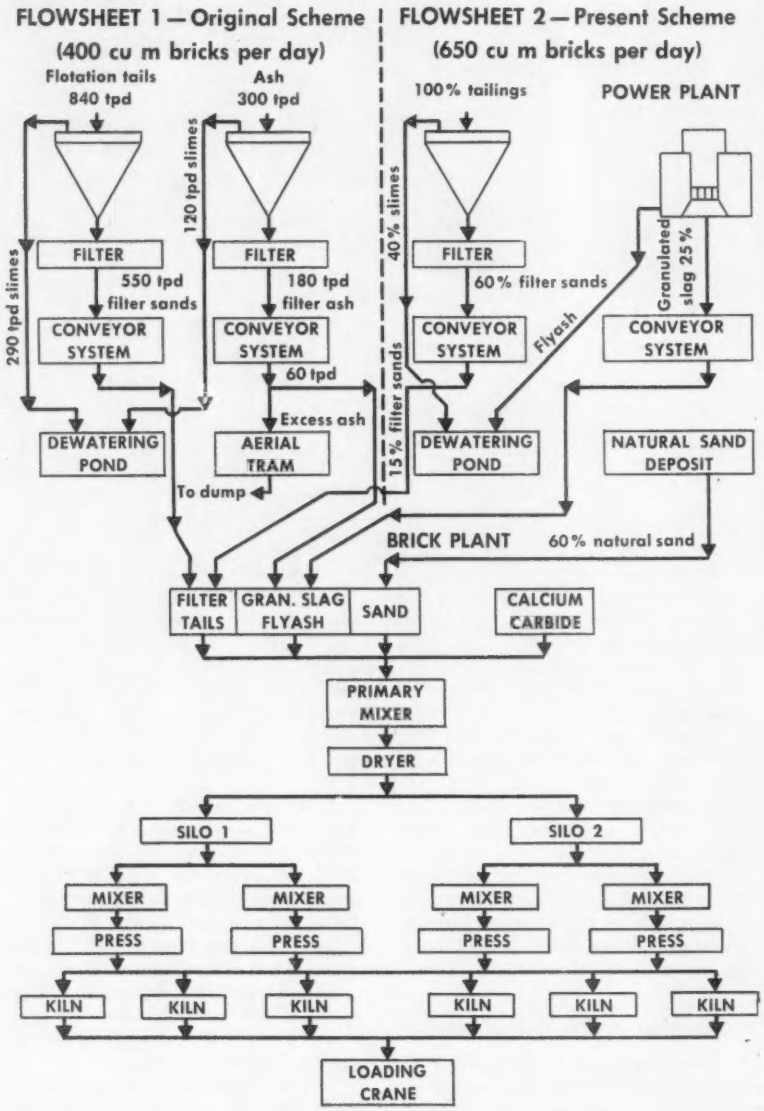
It has been found that steam-hardened building products need a coarser-grained limestone additive than does porous concrete (Porenbeton). With a proper flotation-sand filtered-flyash ratio (these two principal elements make up the mix), the compressive strengths and bulk densities shown in Fig. 1 can be obtained under the conventional limestone process (6-hr hardening at 11 atu) using calcium carbide (Karbidkalk) as a binder. In the area of higher strengths, and with flotation-sand proportions exceeding minimum 70%, the obtained values correspond to the norms covering calcareous sandstone KSV 150.

When the portion of flyash is more than 30%, the resultant bricks or blocks will not be frost-resistant; but they will meet the specifications of conventional bricks. Screen curves for different sands are shown in Fig. 2.

The Auguste Victoria brick plant is designed and equipped to be efficient and flexible. Adequate storage facilities are provided for additives, as are modern measuring and control devices, mixers and presses.

The principal raw materials used in the production of pressed bricks are flotation tailings from the 1,000-tpd lead-zinc concentrator and flyash from the company's power plant. Flowsheet 1 shows how 840-tpd unfiltered flotation tailings and 300-tpd flyash are reduced to brick plant feed, for subsequent conversion into 400 m^3 of pressed brick with a DIN 106 rating. Installation of a sink-float plant at the concentrator reduced the daily tonnage of flotation tailings. Fortunately a source of natural sand was near at hand, to make up the tailings tonnage deficit incurred when the sink-float plant went into operation. Changing the operation of the power plant boilers from a "dry" operation to one of drawing off molten boiler slag stopped the supply of flyash. Instead there

Brick Plant Flowsheet Utilizing Tailings, Flyash, & Slag; Gewerkschaft Auguste Victoria, Marl, Westphalia, Germany



was produced water-granulated boiler slag. The company found that by using tailings sands and granulated slag at a percentage ratio of 60:40 it could obtain tensile strengths from 160 to 230 kg/cm², depending on the rate of compression, specifically at bulk densities at from 1.55 to 1.85 kg/dm³.

Four Sections of Brick Presses

Flowsheet 2 shows the current method of preparing brick plant feed. It contains 15% filter sands, 25% granulated boiler slag, and 60% natural sand. Plant output was increased from 400 to 650 m³ per day of pressed brick with a DIN 106 rating. Calcium carbide is brought to the plant in tank cars, over a rail spur serving the brick plant.

Press equipment consists of four units (three in operation and one on standby or for manufacture of special forms). On a three-shift basis, the three presses turn out some 180,000 1½-NF bricks a day. When the fourth unit is added, then the daily production is 270,000 bricks, plus a modest quantity of other forms. Finished bricks are either stored at convenient points or loaded direct into railroad cars by a gantry crane serving the rail spur and brick plant building.

There are six steam-operated hardening kilns or ovens. Table II lists other brick forms that the plant can turn out under the steam hardening process.

Owing to the use of granulated boiler slag and calcium carbide, the finished stone products are gray-blue in color. If colored facing bricks are desired, then iron oxide colors are added to the materials mixture.

The company also investigated the possibility of using flotation slimes, going to waste, in the production of porous concrete (Porenbeton). In the pilot plant at Auguste Victoria it was possible to produce an acceptable gas concrete (Gasbeton). Here, too, the grinding costs incurred with use of natural sand were saved. The chief materials used were flotation slimes (180 g/dm³) and flyash, with cement and lime as binders.

It was found advantageous to remove the fine clay particles from the slimes by treatment in a hydrocyclone. These are contained in the 70-g/dm³ cyclone overflow. The 750 g/dm³ underflow represents the sand feed for the plant. The materials mixture, in fluid form, is poured into form wagons; and after beating and solidification, the blocks are cut into desired forms for subsequent treatment in steam-operated kilns or ovens.

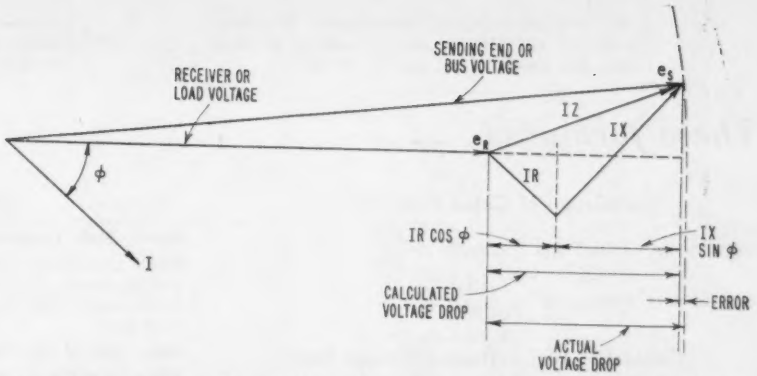
Strength with Light Weight

With optimum mixing conditions, additive to binder, there were obtained very favorable tensile-strength bulk-density characteristics. At a bulk density of about 0.5 kg/dm³, the tensile strengths are 30-50 kg/cm², and at tensile strengths of 70-80 kg/cm², the bulk density is only about 0.7 kg/dm³. This means that there is available a light-weight building material of high value, and one that can be used in the production of wall blocks, armored roof and cover plates, and for insulation.

Production costs are lower than those obtained when operating on a natural sand basis. A plant equipped with a mixer installation and three steam-operated hardening kilns or ovens can produce some 150 m³ of building products per day, if a daily plant feed is 60 tons of slimes (70% <0.1 mm). With the production facilities described, the Gewerkschaft Auguste Victoria is in a position to operate the plants at optimum capacity during periods of change in the character of the raw materials used.

Unfortunately, with the processes now used, it is not possible to beneficiate the large waste dump of flotation tailings, boiler ashes, contaminated waste products and slimes, built up prior to construction of the brick plant. But research in this direction is in progress.

How to Estimate Voltage Drop in AC Mines



VECTOR DIAGRAM of formula "A" shows that, although approximate, the formula is close enough for practical calculations of voltage drop in AC underground mines.

W. J. McDONALD

Mr. McDonald is application engineer, mining industrial engineering section, General Electric Co.

HERE IS A SET OF PRACTICAL TABLES you can use to calculate voltage drop when you do not have a computer handy. They reduce to a reasonable minimum the tedious task of computing operating conditions for an AC underground distribution system.

It is not the purpose of this article to go into all of the factors which determine a well-designed underground AC power distribution system. Rather, the intent is to present some estimating data which can be useful in the design and analysis of such a system.

Most of the work involves looking up and applying values of cable resistance and reactance, transformer resistance and reactance, and motor characteristics to complete simple mathematical calculations. It is common practice to use rules of thumb for motor inrush currents, ratios of reactance and resistance, etc., to arrive at approximate but sufficiently accurate results.

The included tables and formulas are the result of condensing some of this material and rules of thumb, via the mathematic per-unit system, for standard equipments.

Since a large percentage of the load on an AC distribution system is made up of 440 volt squirrel cage induction motors, the tables are made up on a basis of induction motor horsepower. To arrive at the constants in the tables, the following characteristics have been assumed.

Motor voltage rating	440 volt, 3 phase, 60 cycle
Motor power factor - full load	80%
Motor starting inrush	6 times
Motor starting power factor	20%
Motor HP equals KVA	

The basic voltage drop formula employed is:

$$\text{(A) \% voltage drop} = \text{KVA}\frac{(R\cos\phi + X\sin\phi)}{10\,\overline{KV}^2}$$

Where

KVA = Kilovolt amperes (three phase)
KV = Kilovolts (line-to-line)
R = Resistance - ohms
X = Reactance - ohms
ϕ = Power Factor Angle

From the vector diagram above, it can be seen that while formula A is approximate, it is close enough for practical purposes.

It will be noted that the tables are set up for two primary voltages, i.e. 4.16 KV and 7.2 KV. Since power systems are not always rated at these *specific* voltages, it may be necessary to modify the high voltage cable table constants for slight variations from the basic table voltage ratings. To do this, multiply the constants by the square of the ratio of the base table voltage to the system voltage. As a guide, remember that if less than the table base voltage is used, the resulting table constants will become larger. Conversely, if greater than base table voltage is used, the resulting table constant will become smaller.

It will also be noted that the secondary voltage used for determining the table constants is 480 volts. Motors are generally rated at 440 volts. Therefore, the multiplier 1.09 has been applied to several of the formulas to convert calculated percent applied voltages to percent of motor rated voltage.

On occasion, it may be known that motor inrush current will not be 6 times rated. Should this be the case, all table constants associated with starting duty can be converted to an appropriate value by dividing these table constants by 6 and multiplying by the known inrush value in terms of per unit of rated current.

Included is a sample voltage drop calculation of a simple circuit. The sample calculation system is not to be considered a well designed system. It is a hypothetical case and serves only to illustrate the use of the tables and formulas.

Defining Criteria

Cable

Max. KVA	Maximum continuous cable loading to produce cable rated temperature rise in 40° C ambient.
K_R	% Drop per 1,000 ft of cable per 100 HP for motors operating at rated load and speed, .8 p.f. (KVA = HP)
K_S	% Drop per 1,000 ft of cable per 100 HP for motors starting, 0.2 p.f., 6 times inrush.
L	Length of cable under consideration in 1,000's of ft.
HP	Horsepower of equipment under consideration.

Transformers

C_R	Load center transformer % voltage drop per 100 HP for motors running at rated load and speed, .8 p.f. (KVA = HP)
C_S	Load center transformer % voltage drop per 100 HP for motors starting, .2 p.f., 6 times inrush.

P_N High voltage (primary) transformer % voltage drop per 100 HP for motors running at rated load and speed, .8 p.f. (KVA = HP)

P_S High voltage (primary) transformer % voltage drop per 100 HP for motors starting, .2 p.f., 6 times inrush.

These formulas . . .

Calculation of Cable Voltage Drop

(1) Motors at load and speed, $\% = \frac{HP}{100} \times L \times K_N$

(2) Motors starting, $\% = \frac{HP}{100} \times L \times K_S$

Calculation of Transformer Voltage Drop

Load Centers

(3) Motors at load and speed, $\% = \frac{HP}{100} \times C_N$

(4) Motors starting, $\% = \frac{HP}{100} \times C_S$

High Voltage Transformers

(5) Motors at load and speed, $\% = \frac{HP}{100} \times P_N$

(6) Motors starting, $\% = \frac{HP}{100} \times P_S$

System Voltage Drop

Steady State Load—Motors up to Speed

Select appropriate constants (K_N, C_N, P_N)
Use equations (1), (3) and (5) with appropriate operating HP, cable length and transformer. Add results of equations for *total* drop.

Same Normal Operating Load and Starting Load

Select appropriate constants (K_N, K_S, C_N, C_S, P_N, P_S)
Use equations (1) thru (6), with appropriate operating HP, cable length and transformer. Add results of equations for *total* drop.

% Applied Voltage at Load (440 V Base)

Assuming power system supply is stiff—no taps.
(7) (100 — total drop) 1.09

Assuming power system supply is still—taps are used.
(8) (100 ± % taps — total drop) 1.09

Assuming power system is not stiff—taps are used.
(9) (100 — % line drop ± % taps — total drop) 1.09

. . . with these tables . . .

Table I—Portable Low Voltage Mine Power Cable (Type G or Y-Ground)

	600 V Cable — 480 V System		
Cable Size	Max. KVA	K_N	K_S
#6	47	17.67	33.72
#4	61	11.38	23.88
#2	83	7.48	17.70
#1	94	6.14	15.87
1/0	105	5.04	14.01
2/0	122	4.17	12.52
3/0	140	3.47	11.36
4/0	159	2.90	10.36

Table II—Portable High Voltage Mine Power Cable (Type SH-D)

	5 KV Cable 4.16 KV System			8 KV Cable 7.2 KV System		
Cable Size	Max. KVA	K_N	K_S	Max. KVA	K_N	K_S
#4	595	.1547	.354	1086	.0518	.122
#2	782	.1029	.268	1358	.0346	.093
#1	876	.0841	.236	1574	.0283	.082
1/0	1034	.0693	.209	1845	.0224	.073
2/0	1190	.0576	.189	2120	.0195	.066
3/0	1350	.0483	.171	2390	.0164	.060
4/0	1535	.0396	.156	2710	.0138	.055

Table III—Distribution High Voltage Cable (Mine Power)

	5 KV Cable 4.16 KV System			8 KV Cable 7.2 KV System		
Cable Size	Max. KVA	K_N	K_S	Max. KVA	K_N	K_S
#6	565	.2385	.486			
#4	722	.1543	.350	1192	.05165	.1190
#2	941	.1025	.264	1517	.03441	.0912
#1	1068	.0838	.232	1734	.02811	.0798
1/0	1225	.0689	.206	2000	.02318	.0708
2/0	1445	.0573	.185	2330	.01931	.0642
3/0	1600	.0480	.170	2650	.01617	.0582
4/0	1850	.0393	.153	3040	.01362	.0534

Table IV—Mine Feeder Transformer

	5.5% Z*		6% Z*		7% Z*	
KVA	P_N	P_S	P_N	P_S	P_N	P_S
500	.81	6.13	.870	6.38	.990	8.17
750	.54	4.09	.580	4.25	.661	5.45
930	.45	3.41	.483	3.54	.550	4.53
1000	.405	3.07	.435	3.19	.496	4.08
1250	.324	2.452	.348	2.55	.396	3.27
1500	.270	2.04	.290	2.13	.330	2.72
2000	.202	1.53	.217	1.60	.248	2.04
2500	.162	1.23	.174	1.28	.198	1.63
3000	.135	1.02	.145	1.06	.165	1.36

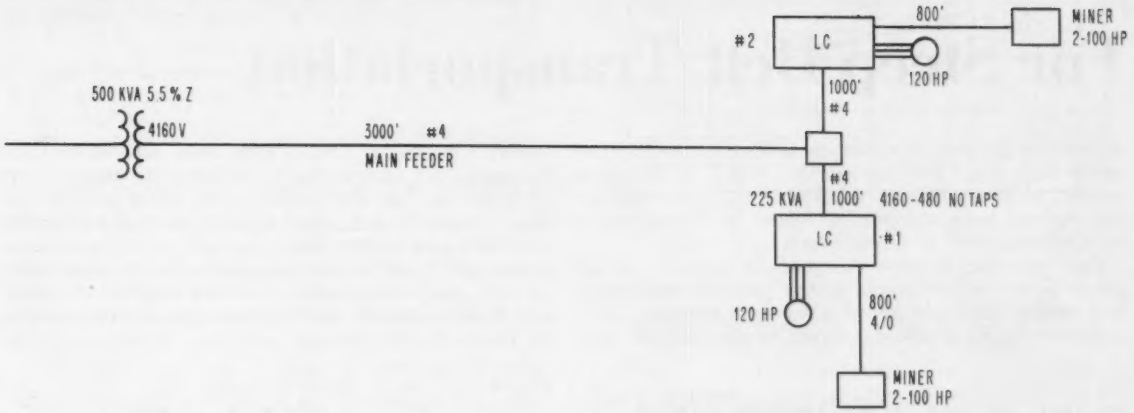
*Select appropriate impedance rating.

Table V—Mine Load Center Transformer

KVA	C_N*	C_S*
150	2.500	17.90
225	1.670	11.90
300	1.250	8.93
500	.750	5.36
600	.623	4.46
700	.500	3.57

*Assumed Transformer Characteristics
R = 1.5%
Z = 4.5%

. . . are used on this system . . .



(1) Load Centers #1 and #2 identical.

(2) Connected loads on each load center are the same and made up of induction motors.

(3) Power system is still.

(4) Diversity factor is 60%.

(5) Purpose of calculation is to determine applied voltage at miners #1 and #2 when:

(a) Miner on Load Center #1 is starting, other loads applied on diversity basis.

(b) All loads are applied on diversity basis.

Note:

When miner starts, only one of the two 100-HP motors is used to accelerate the miner drive to speed.

. . . to give these results:

AC Underground Distribution System; Sample Voltage Drop Calculation

			d			Starting	#1	#2	Normal	#1 & #2
Equipment	P. F.	Table	Const. ×	Feet 1000's ×	10^{-2}	Load During Miner Start ×d =	% Drop Start		Normal Load ×d =	% Drop Normal
M. Transf.	.2	IV-P_S =	6.13	—	10^{-2}	100 HP	6.13	6.13		
500 KVA-5.5% Z	.8	IV-P_N =	.81	—	"	72+192=264 HP	2.13	2.13	384 HP	3.11
5 KV Main Feeder	.2	III-K_S	.350	3	"	100 HP	1.05	1.05	.6×2×	
3000′ #4 MP	.8	III-K_N	.1543	3	"	72+192=264 HP	1.22	1.22	320= 384 HP	1.78
L. C. #1 Feeder	.2	II K_S	.354	1	"	100 HP	.354	—		
1000′ #4 5 KV SH-D	.8	II-K_N	.1547	1	"	120×.6=72 HP	.111	—	192 HP	.297
L. C. #1	.2	V-C_S	11.90	—	"	100 HP	11.90	—		
225 KVA 480 V	.8	V-C_N	1.67	—	"	120×.6=72 HP	1.20		192 HP	3.20
#1 Miner Feeder	.2	I-K_S	10.36	.8	"	100 HP	8.28			
800′ 4/0 600 V	.8	I-K_N	2.90	.8	"	0	—	—	120 HP	2.78
L. C. #2 Feeder	.2	II-K_S	.354	1	"	0	—	—		
1000′ #4 5 KV SH-D	.8	II-K_N	.1547	1	"	(120+200).6= 192 HP		.297	192 HP	—
L. C. #2	.2	V-C_S	11.90	—	"	0	—	—		
225 KVA 480 V	.8	V-C_N	1.67	—	"	192 HP	—	3.20	192 HP	—
#2 Miner Feeder	.2	I-C_S	10.36	.8	"	0	—	—		—
800′ 4/0 600 V	.8	I-C_N	2.90	.8	"	200×.6=120 HP	—	2.78	120 HP	—
							Sum	Sum		Sum
% Drop Miner #1 (480 V Base)							32.37			11.17
% Drop Miner #2 (480 V Base)								16.81		11.17

% Applied Voltage (440 V Base)
Assume No Tap on Load Centers

	Start	Normal
Miner #1 = (100 — 32.37) 1.09	= 73.70%	
Miner #2 = (100 — 16.81) 1.09	= 90.6%	
Either #1 or #2 = (100 — 11.17) 1.09 =		96.7%

The Sandwich Conveyor—A Solution For Steep Belt Transportation

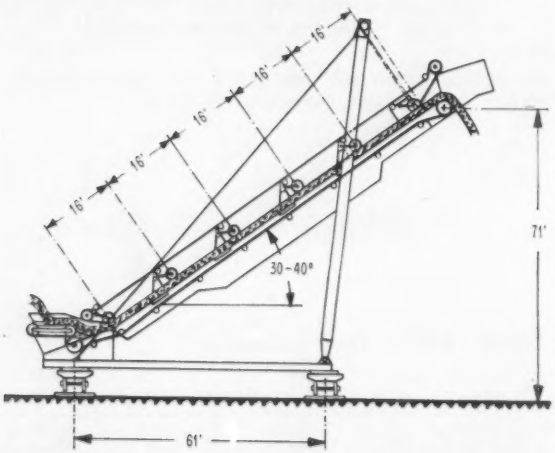
ALTHOUGH GENERALLY REGARDED *as the cheapest form of transportation, the belt conveyor has found limited use in mining. A major limiting factor has been the relatively low angle of inclination possible (about 20° maximum for most material—30° in special cases).*

Early attempts to solve this problem centered on the use of a belt with a profile surface (molded projections) or a troughed belt with lateral idlers set at more than 45°.

Apparently the problem is solved by the sandwich conveyor in use on the LMG bucket wheel excavators. These conveyors can not only work at angles of inclination up to 45°, but they can also handle poorly sorted and wet material. The upper belt, which prevents material from rolling back, assures a uniform flow.

The authors of the following article give the basic theor of their design and practical proof that sandwich conveyo. can be economically used to move mixed-sized materia. up relatively steep slopes.

DR.-ING., DR.-ING. E. H. LUDWIG RASPER
DIPL.-ING. PETER RASPER



POORLY SORTED and wet material can be elevated at a 30° to 40° angle of inclination on mine-tested sandwich conveyor.

THE RECENT DEVELOPMENT of the open cut mining technique makes it necessary to remove, economically, thick overburden covers. Where bucket-wheel excavators work together with conveyor systems, they ensure a continuous flow of material, so that the requirement is realized.

A further improvement of bucket-wheel excavators was achieved by the installation of steep conveyors. Due to the possibility of alternating high and deep cuts, the economy of this combination of machinery is further improved.

On a steep conveyor, the cover belt (sandwich belt) is pressed elastically onto the carrying belt in order to increase the friction surfaces.

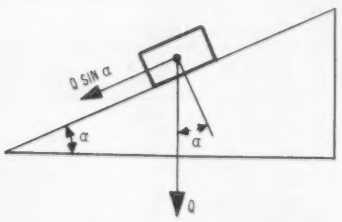


FIG. 1 Balance conditions determine the limiting angle of inclination at which a conveyor belt will convey material.

Dynamics of Inclined Belts

The limit angle of inclination at which a conveyor belt will safely convey material is, in case of uniform speed, v, determined by balance conditions (Fig. 1). When material falls vertically onto the subsequent belt, the material has to be accelerated from v_a to v. During the time of acceleration, the conveyor is not loaded with Q, but overloaded with $Q_x - Q$, if Q_x is the loading at the time of t_x.

$$Q \sin \alpha \leqq Q \cdot \mu \cdot \cos \alpha$$

μ = coefficient of friction between material and moved belt

Q = load through material, in tons per running meter

whereby

$$Q = \frac{L}{v \cdot 3600} \text{ tons per running meter, if}$$

L = hourly output in tons per hr

$$\mu \text{ required} \geqq \tan \alpha$$

$$Q_x \cdot \frac{b}{g} \leqq Q_x \cdot (\mu \cdot \cos \alpha - \sin \alpha)$$

b = uniform acceleration

g = 9.81 m/sec² = earth gravity

$$\mu \geqq \frac{\sin \alpha + b/g}{\cos \alpha}$$

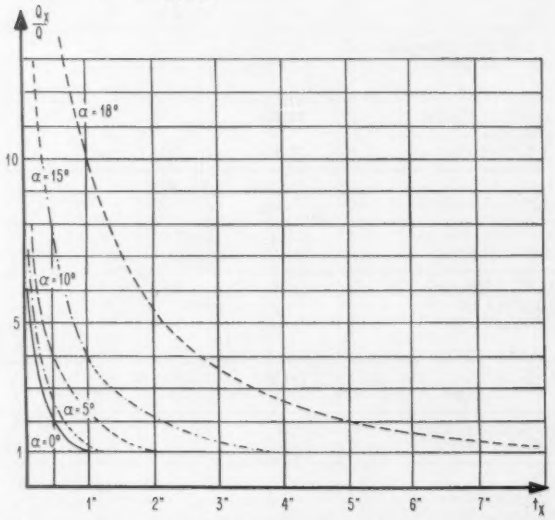


FIG. 2 The starting load ratio is dependent on the angle of slope and inertia constant. Data here are for v = 3.7 m/s; $\mu = 0.364$.

Dr. Rasper is director of Orenstein-Koppel und Lubecker Maschinenbau Aktiengesellschaft, Lubeck Works. Peter Rasper compiled this article from previous writings.

Therefore:
If μ becomes equal to tan α, the acceleration, b, will equal 0; which means that the material will not be taken away by the belt. Further, if $v_a = 0$:

$$v_x = t_x g\,(\mu \cdot \cos\alpha - \sin\alpha)$$

For tan $\alpha = \mu$, t becomes infinite, which means that the required speed will never be achieved.

$$\frac{Q_x}{Q} = \frac{v}{v_x} = \frac{v}{t_x \cdot g \cdot (\mu \cdot \cos\alpha - \sin\alpha)}$$

$\frac{Q_x}{Q}$ is the overload ratio, dependent on t_x and α (Fig. 2). This shows that, where large quantities are to be conveyed over steep inclines, the acceleration of the material should be effected on a horizontal or almost horizontal feeding belt.

Troughed conveyors allow the following angles of inclination for the following materials:

	Angle of inclination (α) Up to	Coefficient of friction (μ)	Angle of internal friction (γ)
Coarse gravel	16°	0.287	33.5°
Overburden, on an average	18°	0.325	31–45°
Large raw brown coal	18°	0.325	35°
Uniformly broken raw brown coal	24°	0.445	41°
Dry sands of uniform granulation	20°	0.364	31°

In literature on earth-moving and construction machinery, higher angles of inclination are often quoted. However, where large overburden and lignite quantities are to be handled by open cut mining equipment with wide and troughed belts, running at speeds between 3.5 m per sec (11 ft 6 in.) and 7.0 m per sec (23 ft), it is impossible to work with such angles. This is mainly due to irregular loading and to the rolling back of large stones and heavy clayey boulders.

The last column indicates the angle of internal friction. Huenerjaeger[8] says that the angle of internal friction, γ, with non-cohesive material, corresponds with the angle of repose to be expected under normal conditions. From tests made, he concludes that the formation of the angle of repose is an entirely dynamic process and that the conditions under which a slope is created influence the "natural angle of repose" to such an extent that almost any slope can be obtained by altering those conditions.

As regards the conveying technique, the angle of repose can therefore be defined as that angle of inclination which is obtained as a result of the loading and conveying conditions.

Steep conveying—as is shown by the above—causes an accumulation of material, which reduces the maximum capacity. This reduction in output is included in the formula (DIN 22 101),

$$Q\alpha = Q_{horizontal} \cdot k,$$

where k is the reducing factor, dependent on the angle of inclination which, for example, at an angle of 20° already reaches the value 0.81.

In the meantime, all of the German belt manufacturers have changed over to troughed belts, with inclinations of 30° and 35° for the lateral idlers.

In 1934, A. Vierling [4] carried out tests with brown coal coke, briquettes, broken briquettes, and overburden, and found that the conical cross-section of troughed belts increases the angle of inclination and the appertaining friction value (μ); whereby, he maintains, it is of no importance whether the material is filled into a troughed belt or onto a surface with moulded projections, provided the size of the projections is in reasonable proportion to the size of the material handled.

Fig. 3, which is a graph of variation of obtainable angle of inclination, shows that results worth mentioning are

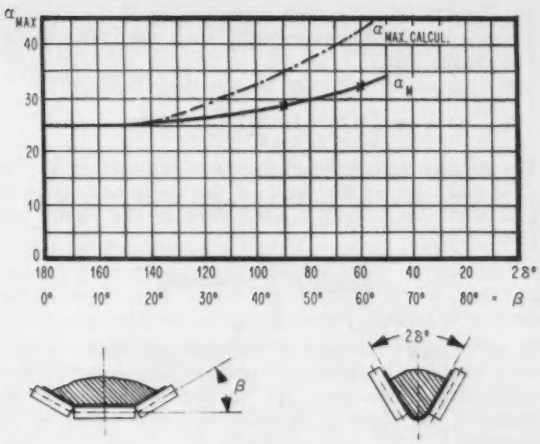


FIG. 3 Maximum angles of inclination of lignite being test-chuted in a wedge-shaped trough (angle of the natural slope is 36° according to A. Vierling).

obtained only with conveyors on which the lateral idlers have an inclination of 45° and more.

Vierling further states that, with a 400-mm (1 ft 4 in.) wide and 22-m (72 ft) long belt with wedge-shaped projections, he was able to maintain with overburden (whose natural angle of repose was 40°) inclinations of 38° to 40° under operational conditions. It is further stated that, with this belt, material of mixed grain sizes can be transported without difficulty on inclination angles 4° or 5° smaller than the natural angle of repose of the respective material.

In 1953, not-published tests were made by another organization with troughed channels and sands of 0 - 20 mm grain size. The material is said to have slid downwards as soon as the inclination reached 28°, irrespective of whether the troughing was 33° or 45°.

Development of the Sandwich Conveyor

A basic formula, Q per running meter = F . γ . 1, serves the balance condition for the quantity of material which is pressed onto the conveyor belt by one meter cover-belt length; provided, however, that at least no longitudinal movement, caused by outside influences, occurs within the material; i.e. cover belt and conveyor belt have to run at equal speeds (Fig. 4).

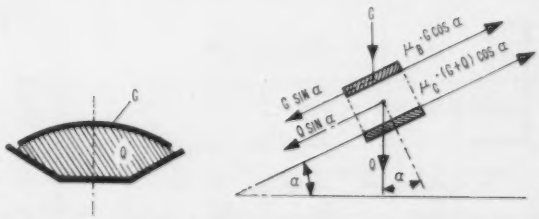


FIG. 4 Basic formula for sandwich conveyor is developed from balance conditions of both conveyor belt and cover belt.

G = wt of a cover belt section in kg per running m
Q = wt of a section of material in kg per running m
P = additional load of cover belt section, measured in direction of gravity, in kg per running m
b = width of belt, in m
F = cross-section of material in sq m
γ = density of charged material, in kg per cu m
α = angle of inclination
μ_B = friction between cover belt and material
μ_G = friction between conveyor belt and material
l = length of cover belt section = 1 m

The friction values, μ_B and μ_G, may differ if the cover belt is made of a different material from the conveyor belt (e.g. chain mats).

The load acting vertically on the steep conveyor is

$$Q_V = Q \cdot \cos \alpha = F \cdot \gamma \cdot \cos \alpha$$
$$G_V = G \cdot \cos \alpha$$

The parallel component of the cover belt section, G · sin α, is taken up by the drive of the cover belt, as is the case with the tangential component of the empty conveyor belt.

Balance Conditions

$$Q \cdot \sin \alpha \leqq \mu_B \cdot G \cos \alpha + \mu_G \cdot (G + Q) \cos \alpha$$

In other words, the total of the frictional forces between cover belt and material, and material and conveyor belt, may not be lower than the parallel component of the weight of the material, in order to avoid sliding of the material.

From this equation, it can further be seen that the drive of the cover belt not only has to take up the parallel-acting portion of the belt weight but also, from Q · sin α, an additional part, up to μ_B · G · cos α, as tractive force. The tractive force of the conveyor belt can be reduced accordingly to

$$Q \cdot \sin \alpha - \mu_B \cdot G \cdot \cos \alpha$$

Dividing this equation by Q · cos α, we obtain

$$\frac{\sin \alpha}{\cos \alpha} = \tan \alpha \leqq \mu_B \frac{G}{Q} + \mu_G \left(\frac{G}{Q} + 1\right)$$

Compromised, the equation is as follows:

$$\tan \alpha \leqq \frac{G}{Q} \cdot \mu_B + \mu_G \cdot \left(1 + \frac{Q}{G}\right)$$

If an additional load, P, per running meter, is added to the load of the weight of the cover belt, the equation is:

$$\tan \alpha \leqq \frac{G + P}{Q} \cdot \mu_B + \mu_G \cdot \left(1 + \frac{Q}{G + P}\right)$$

Assuming an equal friction value between cover belt and material, and material and conveyor belt, the equation is simplified to:

$$G + P = G'$$
$$\tan \alpha \leqq \left[2\frac{G'}{Q} + 1\right] \cdot \mu$$

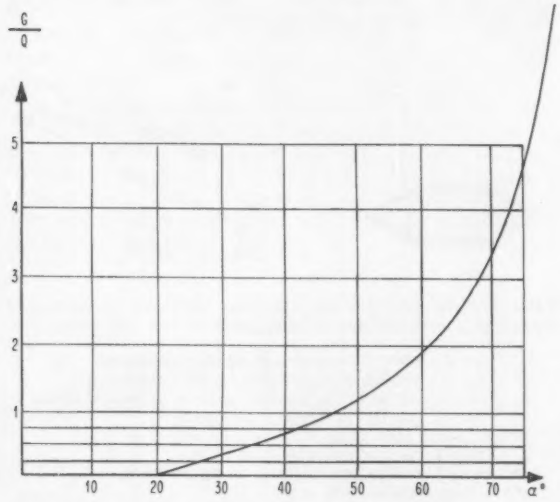


FIG. 5 Load ratio of cover belt in relation to payload is dependent on belt angle of inclination.

In this connection, it may be interesting to know that large-scale experiments, carried out by LMG in 1954, proved that the least driving power is required for the cover belt if cover belt and conveyor belt run at the same speed.

The above equation shows that, with a given quantity of material, each angle of inclination requires a certain cover-belt load. This is shown in Fig. 5, which indicates the relation of G′ to Q for various angles of inclination. Not taken into account is the effect of the traction of the cover belt due to its drive, and the internal friction within the material.

The graph shows clearly that, from a mechanical point of view, a steep conveyor with cover belt can only be economically operated with angles of inclination up to 45°. If steeper angles were used, the weight of the cover belt would have to be considerably greater than that of the conveyor belt. With this method, it is impossible to convey the material vertically. The effect of the internal friction of the material in the case of steep inclination angles is not known.

Conveyors with cover belts prevent the material from rolling back if the conveyor belt is not fully loaded or if large-sized material has to be transported. This protective effect against the instability of the natural angle of repose very likely accounts for the fact that cover belts, which would be insufficient according to the principles of mechanics, in actual operations allow higher angles of inclination, as would be expected from calculations.

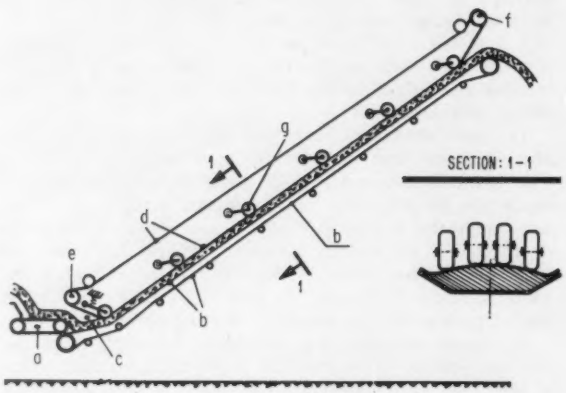


FIG. 6 Principle of the LMG elevating conveyor. a—feed belt, b—conveyor belt, c—intake point, d—cover belt, e—return drum, f—driving drum.

Steep Conveyors Built by LMG

The principal design of the LMG Steep Conveyor is illustrated in Fig. 6. The material dug by the bucket wheel excavator is accelerated by a feed belt, "a," or a rotary plate, and is delivered to the conveyor belt, "b," of the steep conveyor. The cover belt, "d," approaches the conveyor belt via driving drum, "f," and return drum, "e," at the intake and exit points, "c."

Depending on the length of the conveyor and the desired angle of inclination, pressure rollers have been arranged at distances of 5 m (16 ft 5 in.) to 8 m (26 ft 3 in.) (Fig. 7).

The pressure rollers at the so-called intake point must allow the material to pass onto the steep conveyor without causing build-ups, particularly if the material conveyed consists of large-sized pieces.

The intake point "c" is shown in Fig. 8. Pneumatic-tire wheels are suspended by two oscillating arms. Steel or

FIG. 7 Pressure rollers, spaced from 5 m to 8 m, supply required additional load for various angles of inclination.

FIG. 8 At the intake point, pressure rollers, suspended by two oscillating arms, allow material to pass without build-up.

rubber springs exert the required pressure. For belts wider than one meter, up to four pressure rollers are provided.

This arrangement has worked satisfactorily in wet and muddy material, and has also prevented the material from rolling back when it had to be conveyed over steep inclines.

The steep conveyor of a 350-liter bucket-wheel excavator has an hourly output of 1,200 cu m (1,569 cu yd) and can dig from 5 m (16.5 ft) below the track level. The steep conveyor then has an inclination angle of 32° and works very successfuly.

A giant bucket-wheel excavator, Type SRse $\frac{1800}{20}$ 50, works in the deep open-cast Fortuna-Nord mine. Its steep conveyor has a belt width of 2,600 mm and a center-to-center distance of 54.0 m (177 ft). The belt runs at a speed of 3.5 m per sec (11 ft 6 in.); the driving power of the conveyor belt is 1,000 kw, and of the cover belt 480 kw. This steep conveyor is the longest and most efficient existing at present.

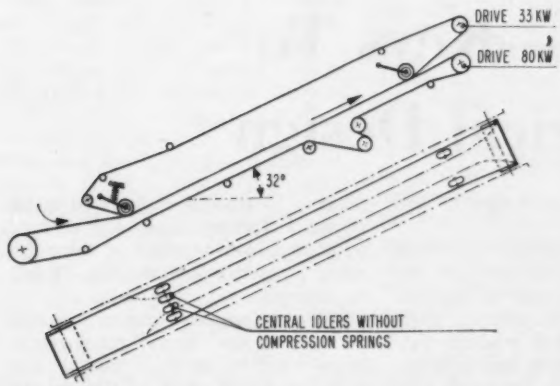


FIG. 9 This conveyor on a 350-liter bucket wheel excavator can carry 1,569 cu yd per hr on a 32° incline.

Large-Scale Experiments With Steep Conveyors

Large-scale tests with steep conveyors were made at the Fortuna Mine between Feb. 19 and March 11, 1954, and among other systems, a LMG steep conveyor was subjected to large-scale experiments. The layout of this steep conveyor is shown on p 100. The experimental plant was fed with overburden and lignite by a bucket wheel excavator with an hourly production of between 1,200 cu m (1,569 cu yd) and 2,400 cu m (3,139 cu yd).

During the tests the efficiency and the proportion of power requirements of cover-belt and conveyor-belt drives were determined. The conveyor belt had a width of 1,800 mm (5 ft 11 in.), and the cover belt one of 2,000 mm (6 ft 7 in.); the belts ran at a speed of 2.96 m (9 ft 9 in.) per sec. The lateral idlers had an inclination of 30°, and the troughing idler sets were 0.97 m (3 ft 2 in.) apart. Distance between the pressure rollers on the cover belt was 5.0 m (16 ft 5 in.).

The results can be summarized as follows:

1. Uniform speed of cover belt and conveyor belt results in the least power for the cover-belt drive, and ensures most favorable conveying conditions.

2. The internal friction angle of the material handled seems to determine the possible angle of inclination of the conveyor.

3. Conveying efficiency decreases with increasing load; therefore the efficiency increases if, with equal contact areas, the load cross-section is reduced.

4. It was possible to convey wet-pit mixtures of sand, loam, and coal without pressure rollers, "g", on a fully loaded belt over inclines of 35°. With moderate loading, 38° angles were achieved.

After the installation of four pressure-roller sets, operation at an inclination of 37° was possible. Outputs were achieved which caused a 50% overloading of the driving motor. Moderate loading made possible, for the same material, an inclination of 40°.

The installation of pressure rollers, therefore, allows an increase in the angle of inclination by a further 5°. This effect, however, decreases if the material concerned is very wet and pulpy. Stones or other material of up to 700 mm (2 ft 3 in.) side length caused no trouble. Coal could safely be transported at inclinations of 40°.

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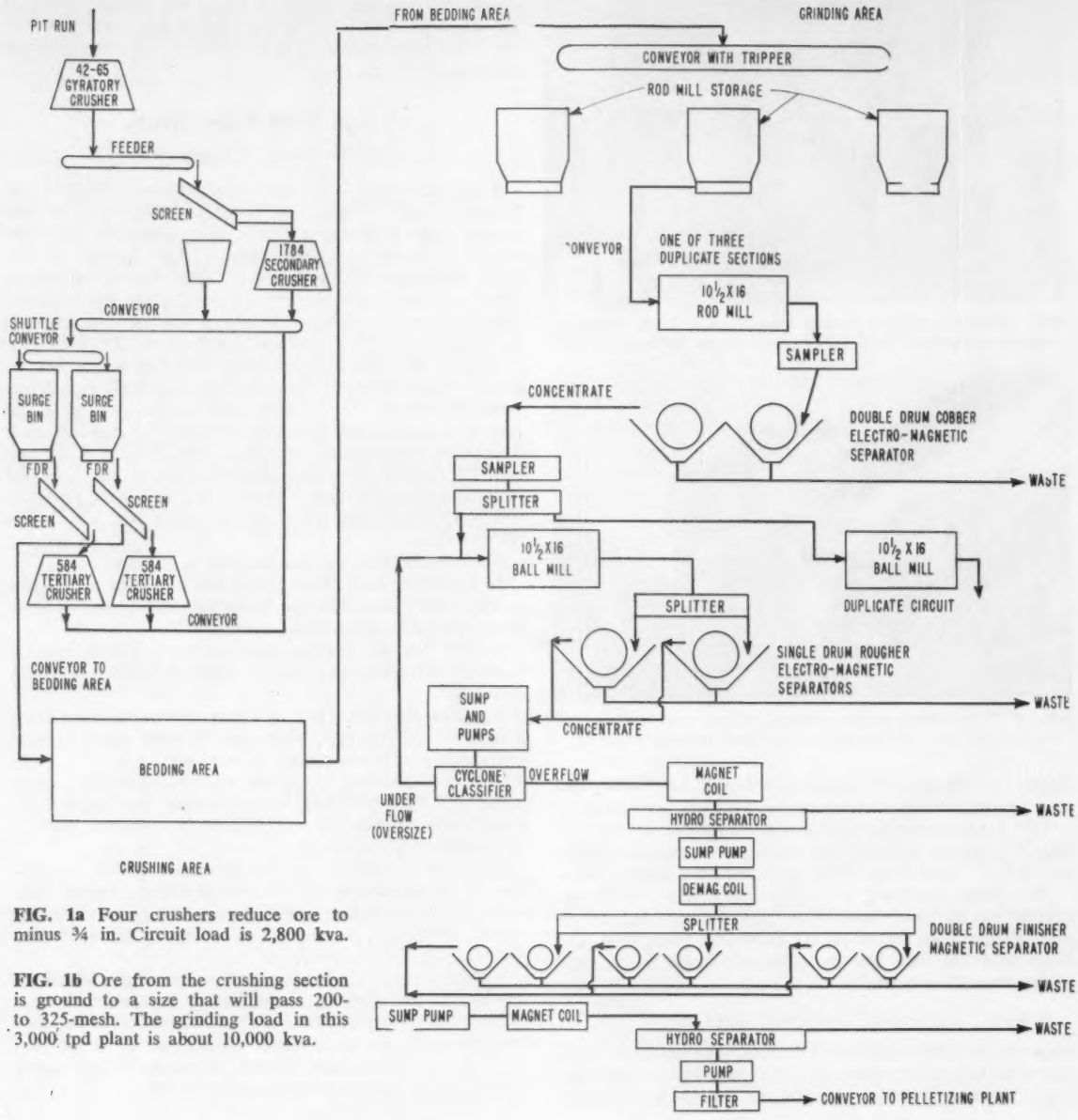

FIG. 1a Four crushers reduce ore to minus ¾ in. Circuit load is 2,800 kva.

FIG. 1b Ore from the crushing section is ground to a size that will pass 200- to 325-mesh. The grinding load in this 3,000 tpd plant is about 10,000 kva.

Automatic Controls—Keys To Modern Plant Electrical Design

W. E. SCHWARTZBURG

MORE ELECTRICAL POWER and more complex control systems are needed to process lower grade ores, especially taconite. If an operation is to be economically feasible, precise automatic control equipment must be employed.

A look at a typical 3,000-tpd taconite plant will illustrate how this power-need problem can be attacked and solved by the designers of processing plants. The plant produces pellets from ore containing approximately 30% iron.

In conjunction with the flowsheets (Fig. 1a, 1b, and 1c) of the taconite plant, a single-line electrical diagram of the pelletizing plant (Fig. 2) and a detailed look at some of the automatic protective devices (Fig. 3) will be covered.

A large primary crusher, usually gyratory or jaw, breaks the material down from its original size to one that can be handled in the second stage of crushing. Generally, a wound rotor motor powers this crusher.

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Crushing Equipment's Electrical Needs Described

At a typical ore-processing plant, a Superior primary gyratory is driven by a 300-hp, 720-rpm belted motor, and has a 42-in. receiving opening. capable of accepting rock about 34 in. in dia. It makes a product of minus-6-in. size. A feeder discharges the crusher product onto a screen, which in turn feeds the secondary crusher that reduces the rock to minus 3 in. The third stage of crushing uses two crushers, which deliver rock of a size that can be fed to the grinding mills, i.e. minus ¾ in.

A single secondary crusher and the pair of tertiary crushers are driven by similar 400-hp, 720-rpm, 2300-v, wound rotor motors. Because these motors drive through V-belts, they are equipped with slide bases and anti-friction bearings. Since the atmosphere is dusty, the bearings are designed with special shields, and the secondary collector rings are enclosed.

The four crushers are furnished with standard control equipment, consisting of high-capacity 2400-v air contactors and five-step secondary control using corrosion-resistant resistors. A great deal of external interlocking is required between the conveyors, crushers and screens.

Some of the interlocks in the conveyor starting circuits are normally set up with time delay relays. As soon as the start button is pushed, an alarm is sounded, and after the time delay (usually 20 to 40 sec) the starter is closed and the motor begins to rotate. This allows enough time for the operator to stand clear. Multiple limit switches detect excessive lateral movement of the belt. Other standard interlock circuits on the conveyor protect against a ripped belt, a slipping belt, overspeed, chute plugging and overloads.

The modern crusher is equipped with a high-pressure lubrication system, which is interlocked with the high-voltage starter, to prevent operation without oil. Because of the long accelerating times in starting crushers (caused by the high inertias and fluctuating loads), special precautions must be taken to protect the motors adequately. These special design features are incorporated in the control euqipment by having the electrical control engineer work in close cooperation with the mechanical engineers who design the crushers.

Total electrical load of the crushers and reclaimer load, which consists of about 500 hp of small motors, miscellaneous cranes, auxiliaries, and screens, (assuming 400 hp of conveyor load) comes to 2,800 kva.

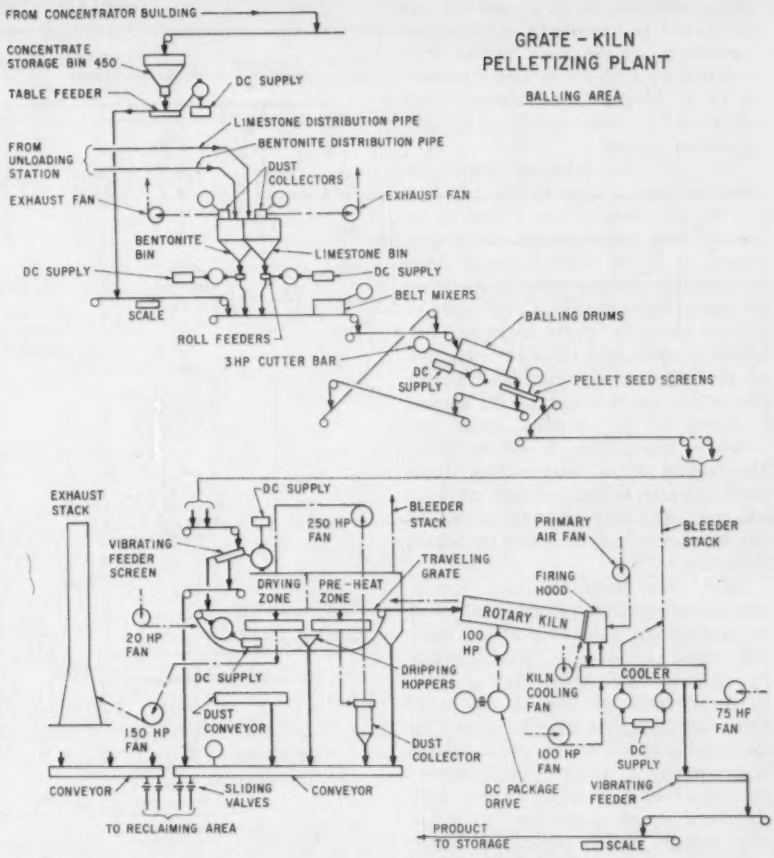

FIG. 1c Only about 15% (2,200 kva) of the total electrical load is used in the pelletizing section. However, various control systems used here are important.

Grinding Mill Motors Are Specially Designed

The second area of the plant is the grinding section, where the ore comes from the crushers at minus ¾ in. and leaves at a size that will pass 200- to 325-mesh. The first stage of grinding comprises three rod mills, which, in this application, are driven by 800-hp, 2400-v, 240-rpm synchronous motors.

Specially designed, these mill motors have starting torques of 160%, pull-in torques of 140%, and pull-out torques of 225%. The discharge of the rod mills is fed to magnetic separators. This method of concentration imposes an electrical load of approximately 800 kw. Three-phase, 440-v power is converted to 230-v dc, which is fed to the magnets.

Concentrates are fed to a line-up of six ball mills, each identical to the rod mills except that each is driven by a 900-hp motor. The material then passes through six secondary magnetic separators, before being pumped to wet cyclone classifiers. The pump load consists of six 100-hp, 1200-rpm, TEFC squirrel-cage motors. When the dc and ac load requirements are combined, the grinding load in this 3,000-short-tpd plant comes to about 10,000 kvá.

Next stage, following grinding, is the pelletizing section. In terms of kilowatt-hours billed, the electrical requirements are modest. In this plant the pelletizing area's connected load would be 2,200 kva, or only about 15% of the total electrical load. The interesting applications are control problems involved in critical areas.

"Magna-Speed" Drive Furnishes Close Control

A single line diagram of the electrical drives is shown in Fig. 2. This drawing shows the equipment for two lines, each capable of producing 3,000 tpd. A table feeder passes the ore concentrate to a mixer, located on each balling-drum feed conveyor,

where bentonite or limestone and ore are mixed in transit, in definite proportions by weight. Each balling drum is driven by a 60-hp dc motor, powered by a "Magna-Speed" drive, which allows ±1% speed control at all baling-drum speeds.

Basically, this drive provides regulated variable voltage to the armature of the dc drive motor. Thus it replaces the conventional motor-generator in a dc Ward-Leonard drive system. The drive system is made up of conversion equipment consisting of silicon rectifiers, static magnetic amplifier control and saturable reactors, to give stepless accurate control over the entire speed range of the motor.

Speed of the drum's cutter bar bears a relationship to the speed of the balling drum. The balling drum must operate within a range of 8 to 16 rpm, and the optimum speed of the two units is determined by actual operation.

After this speed has been found, another production variable that must be determined is loading of the balling drum. Loading is accomplished by an automatic signal from a scale to the control winding of the magnetic amplifier that supplies power to the ore-bin table feeder. This feeder is driven by a 10-hp TEFC motor, capable of 400% starting torque, with six-to-one speed regulation by armature voltage. When placed in "automatic" position, the 0.5- to 5-milliamp signal from the scale regulates the voltage applied to the armature of the motor. When placed in "manual" position, the speed is controlled by a manually operated rheostat, located on the scale controller.

The 60-hp balling-drum motor is a dc machine equipped with air-to-air heat exchangers and a tachometer. The tachometer supplies a feedback signal as well as a voltage for a speed indicator.

Flow of material from the grate through the kiln to the cooler and storage is indicated in Fig. 1c. The grate is driven by a 10-hp, 1750-rpm-base-speed motor with a 4-to-1 speed range (downward). Control of this drive is manual, with provision for future automatic control. The kiln is driven by a 100-hp, 230-v dc motor, which is part of a package drive. The motor-generator set supporting this motor is completely housed in a forced-ventilated cubicle, which also contains all of the control components. The speed of the stabilized shunt-wound drive motor is continuously adjustable, from 1150 down to 287 rpm. Provision is made for regulating the speed of the kiln motor by a signal from the grate motor tachometer, so that the grate and kiln speeds will be automatically coupled.

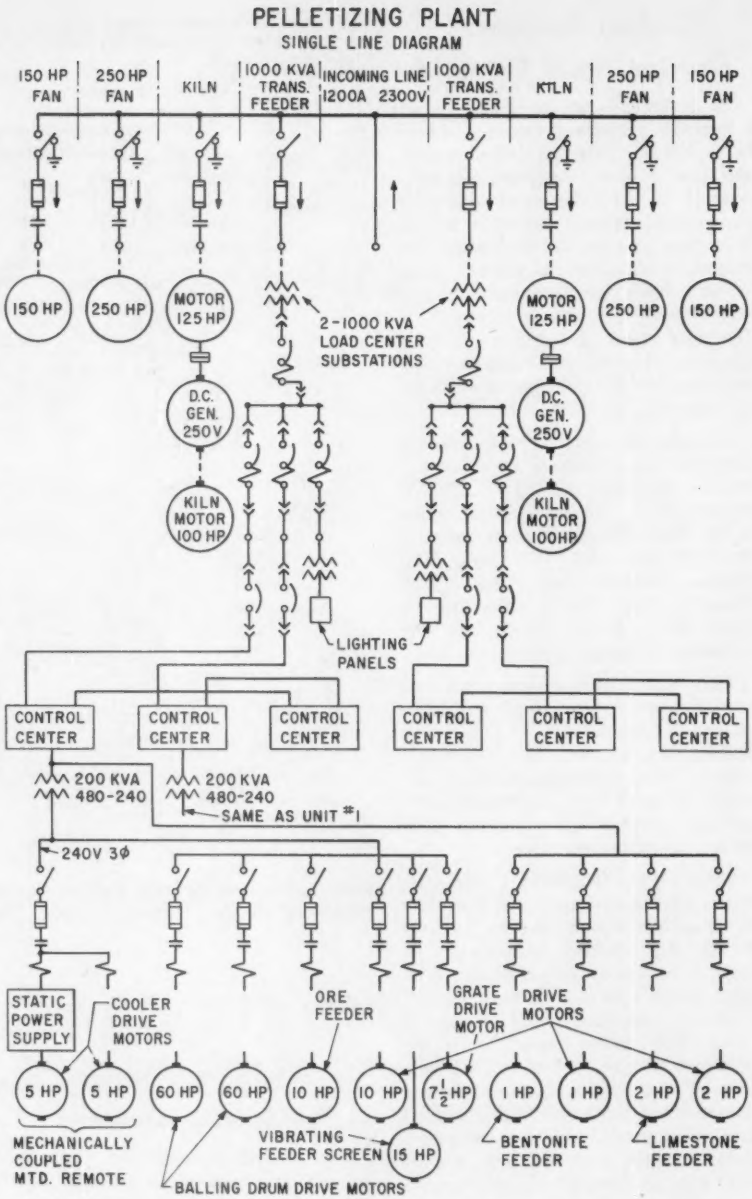

FIG. 2 Stepless accurate control over the speed range of the balling drum motors is provided by silicon rectifiers, magnetic amplifiers and saturable reactors.

Pellet Bed Depth Is Radioactive-Controlled

When the pellets reach the required temperature in the kiln, they are discharged to the rotating cooler. The operation of this cooler is critical; for if the drive were to fail when the kiln was loaded, a pile-up of high temperature pellets could cause damage.

Optimum operation of the cooler is obtained with a 30-in. depth of pellets. Since this bed depth is critical, it is continuously monitored by a gamma ray level gage. The isotope Ce-137 is utilized. When the depth varies, a varying signal is sent to the control winding of the "Magna-Speed" magnetic amplifier, and the cooler drive motors are either speeded up or slowed down. This radioactive depth control, known as "Nucontroller," provides extremely accurate control, with no physical contact with the high-temperature material in the cooler.

To assure continuous operation, the cooler control is set up for 240-v, 3-phase, 60-cycle operation, and a

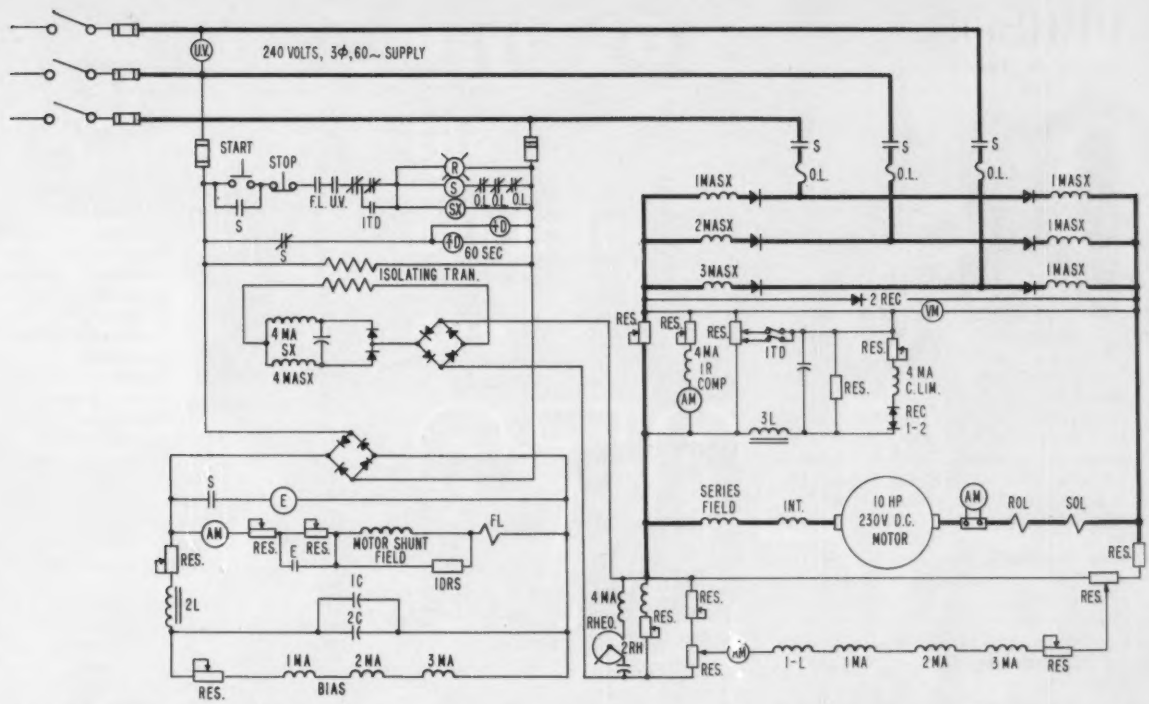

FIG. 3 Schematic diagram of ore table feeder. A totally enclosed dc motor drives the rotating table. A regulating scale controller controls the quantity of ore supplied. At a given scale control value, the ore supply rate is held constant.

gasoline-engine generator stands ready to provide power in the event of a line outage.

The upper portion of Fig. 2 is an electrical single line diagram showing the 2,300-v incoming line and the motor loads. The 440-v starters are conventional motor control centers, and the equipment is housed in an air-conditioned control room. All motors 125-hp and larger are 2,300-v, and are connected to the 2,300-v bus through high-capacity air-break contactors, capable of interrupting 50,000 kva. Two standard 1,000-kva unit substations supply the 440-v power requirements. The "Chlorextol" transformers are located outside the building, and the switchgear is connected to the low-voltage side by bus duct.

Centralized control is provided by a standard kiln control panel. The speed of the grate and kiln is normally under manual control by the "burner" or kiln operator.

Automatic Protective Devices Are Detailed

A look at Fig. 3, which shows an ore table feeder, shows how a regulated system performs, and how it is protected. Look at the drive on the feeder.

A totally enclosed dc motor drives the rotating table. A regulating scale controller controls the quantity of ore supplied. It does this as follows:

The control signal of the sensing device is fed back into a static magnetic preamplifier. The signal from this preamplifier is fed to the main power amplifier, to raise or lower the dc voltage applied to the motor armature. Controlling the armature voltage gives a speed range of six to one; no field control is needed.

So, when the operator sets the scale control at a given value, the motor speeds up or slows down as necessary to hold the ore supply rate constant.

The voltage drop across a resistor in series with the armature is used to provide a signal to the main amplifier, to supply IR compensation. Thus an increase in current will cause a rise in output voltage, to counteract the IR drop of the loop.

Supply to this "Magna-Speed" drive is 240-v, 3-phase, 60-cycle. Short-circuit protection is provided by fuses, and under-voltage protection is afforded by a separate relay. Three overload coils are provided in the ac starter; and dc current limit and loss of field are standard items. This particular motor is designed to furnish 400% starting torque; and for that reason, timing relays are used to bypass the dc and ac overload protection during starting. Current-limit protection is obtained by a voltage-dropping resistor, similar to the IR compensating circuit. Located in the armature circuit are dc overload relays.

Precise Control Needed In Processing Plants

It can be instantly recognized that ore processing plants, to be economically feasible, must have precise control of both electric and thermal energy. In this typical plant, the connected load is 15,000 kva, distributed to the three general areas as follows:

Area	Load	% of load
Crushing	2,800 kva	18.67
Grinding & concentrating	10,000 kva	66.67
Pelletizing	2,200 kva	14.67

Because the lower grades of ore now available need more power to recover and process them, electrical requirements are steadily increasing in both magnitude and complexity. Consequently, more study of electrical needs and ways to supply them is imperative in the ore processing industry.

PERSONALS

Vincent N. Burnhart has been elected president of E. J. Longyear Co. to succeed Donald M. Davidson, who died recently.

Burnhart

Burnhart, formerly vice-president and general manager, joined the company in 1946. He is a director of the company and of Canadian Longyear Ltd. He also is president of the Diamond Core Drill Manufacturers Assn.

Longyear directors also have named four new vice-presidents. They are **Rudolph C. Gebhardt,** mining; **Michal J. Gleason,** contract drilling; **Eugene Larson,** marketing; and **John F. Hoffmeister,** manufacturing.

John W. Currie has been named resident manager for the Spokane office of American Zinc, Lead & Smelting Co. Currie has been serving as resident manager for the firm at the Grandview mine and mill in the Metaline district of Wash.

He is a member of the advisory board of the Washington State University Institute of Technology, the Governor's safety advisory committee, the Northwest Mining Association board of trustees, and the AIME.

John H. Lucas has been appointed assistant general superintendent at Permanente Cement Co.'s Cushinbury plant, Lucerne Valley, Calif.

William D. Miller was elected executive vice-president and director of Consolidated Aluminum Corp. Miler joined the company on Mar. 1, 1960, as vice-president. He was formerly vice-president of Continental Copper & Steel Industries Inc.

Harold E. Robbins, formerly general superintendent of Andes Copper Mining Co., Potrerillos, Chile, has been promoted to the position of assistant manager. He will be in direct charge of the company's El Salvador copper mine and concentrator project.

Robbins

Mr. Robbins began his employment as a mine foreman with Andes Copper in 1938. He moved up through the positions of general mine foreman, assistant mine superintendent, and mine superintendent, and in 1953, he was named general superintendent.

Robert G. Axtell has been appointed to the newly created position of director of marketing (fabricating operations) for Cerro de Pasco Corp.

Harry D. Wallach has been appointed vice-president and general manager of Howe Refining Co., a subsidiary of Howe Sound Co. Wallach was formerly vice-president of the nonferrous division of Frank Samuel & Co.

John R. Freeman, Jr., vice-president, metallurgy and research, American Brass Co., has retired. He now serves as a metallurgical consultant to Anaconda Sales Co., and will continue to represent Anaconda as its technical representative in the Copper Products Development Assn. Freeman's duties have been assumed by **Gilbert C. Strubell,** administrative director of metallurgy and research.

Freeman

Nock

Walter J. Nock has been appointed vice-president in charge of the Mexican Div. of American Smelting and Refining Co. He was formerly general manager of Asarco's Mexican Mining Department.

Richard V. Colligan has been elected vice-president of Freeport Sulphur Co. His last post, which he retains, is that of president of the Moa Bay Mining Co., a Freeport subsidiary.

Cooligan was first employed as an assistant geologist by Cuban Mining Co. and became mining superintendent in 1943 of Nicaro Nickel Co.

Colligan

Haller

Francis J. Haller has been named a director and consultant of Jubilee Iron Corp. He was formerly vice-president of North Range Mining Co. and now is its consultant.

The famous Mather mine was developed under Haller's supervision. He was instrumental in making the first American installation of the Koepe Hoist at the Cliffs shaft mine of Cleveland-Cliffs Iron Co.

A. R. O. Williams, a managing director of Consolidated Gold Fields of South Africa Ltd., and of New Consolidated Gold Fields Ltd., has been elected president of the Institution of Mining and Metallurgy, London, for 1961-62. He will succeed Prof. **David Williams.**

Ronald R. McNaughton was elected president of AIME for 1961. He will succeed **Dr. Joseph L. Gillson.** McNaughton is manager, Metallurgical Div., Consolidated Mining & Smelting Co. of Canada Ltd.

McNaughton

Lloyd E. Elkins, production research director, Pan American Petroleum Corp., will become AIME president-elect in February, pointing toward his election as president for 1962.

New vice-presidents (one-year terms) will be **John S. Bell, Wayne E. Glenn, Dr. Carleton C. Long, John S. Smart, Jr., Dr. Arthur B. Cummins** and **Jerome W. Woomer.**

New directors (three-year terms) will be **Robert B. Gilmore,** representing SPE; **Richard C. Cole,** representing the Metallurgical Society of AIME; **Karl L. Fetters,** representing the Metallurgical Society; **William B. Stephenson** and **Clark L. Wilson,** representing the SME.

Ffloyd H. Shellenberger has been appointed mill superintendent of the Grandview mill of American Zinc, Lead and Smelting Co. at Metaline Falls, Wash. He succeeds **D. A. Underwood,** who has resigned.

Shellenberger joined the company in 1952 as chief chemist. In 1956 he was appointed mill metallurgist.

Peter A. Zampino has been named manager of metallurgical services, Pennrold Div., Brush Beryllium Co. In this position he is responsible for process metallurgy and applications development for division products, which include precision-rolled beryllium copper and other alloy strip.

Keith O'Donnell has been appointed general manager of Frontino Gold Mines Ltd., Colombia.

James E. Boyce has been elected vice-president, Kaiser Engineers International. He will be responsible for the firm's engineering and construction activities in Europe, Africa and the Middle East.

Boyce

Boyce was employed by Lockheed Aircraft Corp. for more than twenty years, prior to joining Kaiser. Most recently, he was Lockheed's director of sales in Australasia and the Far East, resident European manager, and director of export sales.

Bill E. Christian was appointed direc-

(Continued on p 113)

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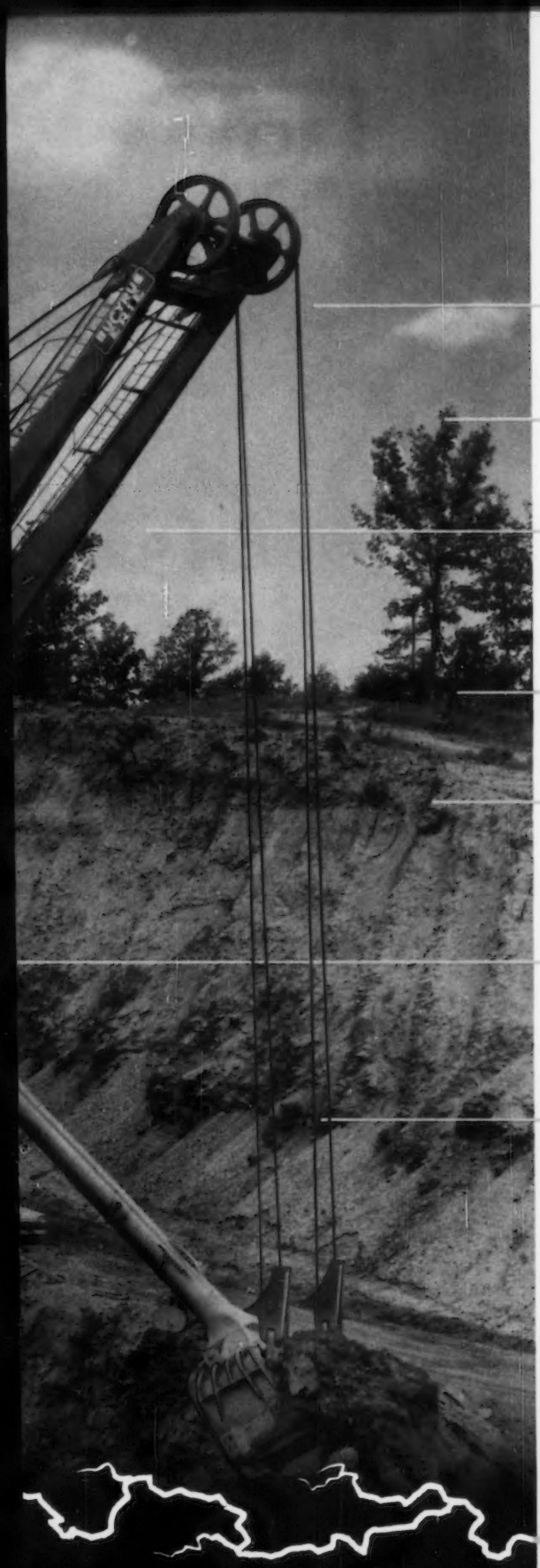

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If you need BIGGER excavator performance for bigger hauling units . . . deeper overburden . . . bigger construction jobs, the 270-B is worthy of *investigation by any standard of comparison!*

READ ABOUT DYNAMIC NEW STATIC CONTROL

the only moving part on this system is the operator's hand on the controller!

What is Bucyrus-Erie STATIC CONTROL?

It is a new concept in electric excavator control utilizing solid state components in place of rotating units and/or electronic tubes. It has no moving parts. It will continue to perform consistently year after year!

Previous systems have been adaptations of existing control devices to excavator service. *This is the first system designed to obtain specific digging characteristics.*

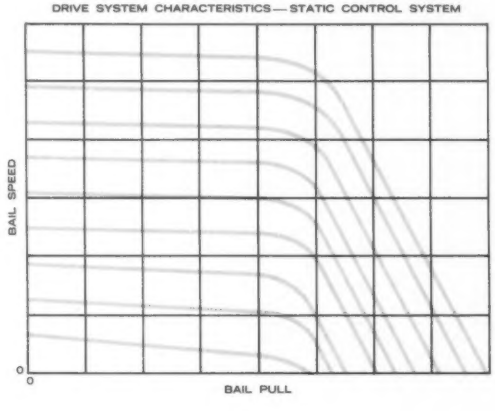
How does this system help you increase production?

STATIC CONTROL provides instantaneous response with higher bail pull at any selected speed. Shock loading is reduced . . . greater digging force and speed are available when you need them!

What is the life expectancy of the STATIC CONTROL system?

Unlimited! Because no deteriorating action takes place in the system, it has unlimited life under normal conditions. All components are military type — heavy-duty. All reactor and semi-conductor devices are sealed to prevent entry of dust and moisture. Maintenance is simplified by the use of unitized assemblies. Control panels are interchangeable and easily replaced!

THE NEW 270-B with dynamic STATIC CONTROL — a worthy addition to the *industry's first line of excavators!* Find out all the details as they apply to your specific operations. Write Bucyrus-Erie Company, South Milwaukee, Wisconsin, *today!*



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PERSONALS (*Continued*)

tor of industrial and public relations at the White Pine operations of White Pine Copper Co. He was formerly employed by Kennecott Copper Corp. as director of industrial relations at its Chino Mines Div.

James C. Gray, administrative vice-president, raw materials, U.S. Steel Corp., was elected president of the Society of Mining Engineers, AIME. He will succeed **Dr. Arthur B. Cummins.**

Others who will also take office for three years at the AIME Annual Meeting have been elected as follows: **Edward G. Fox,** to be vice-president of SME for the Eastern Region; **Dennis L. McElroy,** to be a director, Coal Div.; **Raymond H. Feierbend,** to be a director, Industrial Minerals Div.; **Wayne L. Dowdey,** to be a member of the Board of Directors, Minerals Beneficiation Div.; and **Alfred D. Rood** and **Frederick S. Turneaure,** to be directors, Mining and Exploration Div.

Fiedler

Colefax

Peter Colefax, president of American Potash & Chemical Corp., has been named by the directors to fill the position of Chairman of the Board. He also will continue as president, in which capacity he has served since Feb. 21, 1947.

Dr. William M. Fiedler has been appointed assistant general manager, planning and development, for the Ore Mines and Quarries Div. of Jones & Laughlin Steel Corp. He was formerly J&L's chief geologist.

New chief geologist for the company is **Edward L. Beutner,** and new chief mining engineer is Dr. **Robert M. Crump.**

OBITUARIES

Donald M. Davidson, 58, president of E. J. Longyear Co. and a geologist with a world-wide reputation, died suddenly Sept. 15. He had been president of Longyear Co. since June, 1958.

After receiving a Ph.D. from the University of Minnesota in 1928, Dr. Davidson joined Selection Trust Ltd. and became chief geologist and senior engineer in 1939. From 1950 to 1952 he was a member of the National Minerals Advisory Council. From 1953 to 1954 he was president of the Society of Economic Geologists. He served as a consultant to the AEC, Bureau of Mines, Corps of Engineers, the President's materials policy commission and many other government boards and commissions.

He was a member of the American Assn. for the Advancement of Science, AIME, Canadian Institute of Mining and Metallurgy, American Geophysical Union, Washington Geological Society, a fellow of the Geological Society of America and of the Institute of Mining and Metallurgy, London.

Davidson joined Longyear in 1939 as chief geologist. He was later head of the Mining Division and became vice president in 1949.

Jesse O. Betterton, 76, metallurgist and former director of research for American Smelting & Refining Co., died recently in Capistrano Beach, Calif. He played an important role in the construction of the Mulungushi Dam and in the development of the smelting and refining process of the Broken Hill lead and zinc smelter in Northern Rhodesia.

Also among his contributions were the Betterton process of lead refining, involving the passing of chlorine gas through molten metal to preferentially remove impurities; the Betterton-Kroll process of debismuthizing lead by calcium and magnesium additions; and the Asarco process of continuous casting of oxygen-free copper through a graphite mold.

As an employee of Asarco, he helped to build, revise and manage lead refineries in the U.S., Mexico, and England. In 1940, at his retirement, he was director of research and manager of lead refineries and Atlantic Coast refineries for Asarco. He was the holder of some 80 U.S. patents in nonferrous refining.

Carl W. Collins, 52, senior mine engineer, Sullivan mine, Consolidated Mining & Smelting Co., died suddenly on Aug. 24.

Collins joined Cominco in 1941, working at the Pinchi Lake mercury mine and as mine superintendent at the Con mine at Yellowknife, N.W.T. From the Con he was transferred to the Sullivan mine at Kimberley, B.C.

Robert W. Hughes, 68, former vice-president and general manager of Miami Copper Co., died recently in Phoenix, Ariz.

Hughes went to Arizona in 1916 and worked for Inspiration Copper Co. for nine years. He joined Miami Copper in 1925 as chief mine engineer, and moved up to the general manager's post before retiring.

Wayne Clark, 31, foreman at the Federal - Gas Hills Partners' uranium mill in the Gas Hill area of central Wyoming, died of polio Sept. 6.

Clark, formerly of Grand Junction, Colo., had been employed by Federal - Gas Hills since October 1959.

Edmond V. Given, 54, mill superintendent, San Manuel Copper Corp., died Sept. 8. A native of Newcastle, Wyo., Given filled supervisory jobs in Ariz., Calif., Mexico and North Africa.

Given was foreman of the old Arizona Magma operations. Chloride, Ariz., from 1937 to 1940. He helped build lead and zinc stockpiles in Calif., Utah, and Sonora, Mexico, until 1944, when he returned to Ariz. to work on the Coronado copper and zinc mill.

In 1945 he was named mill superintendent at the Tiger properties of the Mammoth - St. Anthony development. He moved to Morocco in 1947 to become director of two mills for a French company. In 1955 he returned to Arizona to become superintendent of the San Manuel mill.

Clarence Blumoehr, 58, assistant to the president, Phelps Dodge Copper Products Corp., died suddenly at his home in Staten Island, N.Y.

Blumoehr started his career in 1918 with Habirshaw Cable & Wire Corp., which was later acquired by Phelps Dodge.

During the Korean War, he was director of the Wire Mill Branch Copper Div. of the National Production Authority in Washington, D.C. Later, he was a consultant to the Copper Division and was a member of the executive reserve of the Dept. of Commerce.

Frederick E. Burbidge, 96, long-time mining industry executive in the Northwest and former general manager of Bunker Hill & Sullivan Mining & Smelting Co. (now Bunker Hill Co.), died Sept. 11 at Spokane, Wash.

Born in England, he came to the U.S. in 1886 and started his mining career at Butte, Mont. He later served as general manager for Bunker Hill and, from 1916 to 1930, served as general manager of the north Idaho properties of Federal Mining and Smelting Co. He was a 50 yr member of AIME.

Willett E. (Bill) Holiday, 63, chief chemist for the Oliver Iron Mining Div.'s Hibbing-Chisholm area, died on Aug. 8 after a short illness. Born in Davenport, Iowa, he graduated from Iowa State University. He joined the Oliver Iron Mining Co. in 1922 at Virginia, Minn., and in 1926 was transferred to Hibbing. He became asst. chief chemist in 1938 and chief chemist of the Hibbing-Chisholm district in 1954. He was well known and well liked on the Mesabi Range.

W. P. Mars, Duluth, died on Aug. 9 at 93. He was born in Chicago in 1866 and went to Duluth in 1897. With his son, he founded the W. P. & R. S. Mars Co. in 1922, a mining supply business still active under the direction of his son and grandson.

Edwin C. Jones, 75, died in Glendale, Calif. He began his 45-yr career with the Oliver Iron Mining Co. in 1905 as a chemist in Eveleth. He was transferred to Ely, on the Vermilion Range, as chief chemist, and in 1940 he became asst. general superintendent of Oliver's Vermilion Range mines. Later he was appointed asst. general superintendent of the company's eastern div. at Virginia. He held this position until his retirement in 1950.

NEW BOOKS

Carcinogenic Bioassays on Air Pollutants, by members of the National Cancer Institute, University of Southern California, and the Robert A. Taft Sanitary Engineering Center. This investigation was made because of the marked increase in the incidence of lung cancer in industrial nations during the past 33 years. The lung cancer death rate in England has jumped from 10 per million in 1920 to 350 per million in 1950. In the U.S. the rate has increased from 20 per million in 1930 to 150 per million in 1953. Suspected causes of lung cancer are radioactive minerals, industrial and industrial-related air pollutants and cigarette smoking. In cities with a population of more than 1-million the mortality rate for smokers is 48.5 per 100,000, whereas for non-smokers it is 14.6. This report merits the serious consideration of all industrial hygiene departments, particularly in those industries responsible for air pollution. Some of the tables pertaining to metals and minerals, and certain occupations in mining and mineral processing industries indicate places where rigid dust control may be required. Prepared by the U.S. Department of Health, Education & Welfare, Public Health Service, Washington 25, D.C. Pp 19 plus numerous maps, charts and tables.

Engineering Mathematics, by J. Blakey and M. Hutton, Sunderland Technical College. This book covers the mathematics needed for a degree in engineering in most universities. It is based on Dr. Blakey's well-known University Mathematics. The more theoretical chapters have been removed and replaced by chapters on the numerical solution of equations, statistics, relaxation methods and Laplace transformations. Published by Philosophical Library Inc., 15 E. 40 St., New York, N.Y. Pp 601. Price $10.

Explorations East of the High Andes, from Patagonia to Amazon, by Victor Oppenheim. High adventure and science go hand in hand in this breathtaking account of the experiences of a geologist as he investigates the hitherto unexplored or little known regions of the Andes Mountains. Searching for oil, gold, diamonds, and other minerals, the author takes the reader along as he climbs some of the highest mountain ranges in the Western Hemisphere, or as he slashes his way through inaccessible rain forests and impenetrable tropical jungles. Seven sketch maps show areas explored and routes followed by the author in inaccessible areas. Here are some random quotes to illustrate the adventure and excitement of the books: "We killed several dozen of these pests (fer-de-lance), as well as several bushmasters and coral snakes." "In the next moment peccaries appeared from everywhere, furiously grunting and gnashing their teeth." "Here it was necessary to note that most of the Amazon Indians were able to count only to three." "Some Bolivian anthropologists were inspired by the notion that the earlest Homo sapiens must have come from the Tarija Basin in Bolivia, where an abundant Pleistocene fauna of extinct mammals was known for years and where this massive skull of 'Homo primigenius' was found." "South American diamonds are associated in their origin with old igneous rocks of the basement complex and old granites, particularly pegmatites of the Pre-Cambrian age." Published by Pageant Press Inc., 101 Fifth Ave., New York 3, N.Y. Pp 267. Price $5.

Welded Steel Conveyor Pulleys—Recommended Load Ratings for Standard Pulleys. MVBD & MPTA Standard No. 301, 1960. Tables give pulley loading rates for pulleys from 6 to 60 in. in dia for various widths and shaft sizes. Prepared by the Steel Pulley Engineering Sub-Committee, Multiple V-Belt Drive & Mechanical Power Transmission Assn., 27 E. Monroe St., Chicago 3, Ill. Pp 16. Price $1.

Geology of the Manitouwadge Area, by E. G. Pye. This report of a new and active mining area northwest of Marathon, Ontario, includes photos, plans and geologic sections of the Geco Mines property. Published by the Ontario Department of Mines as Vol. LXVI, Part 8, 1957. Pp 114 plus geologic map.

BOOKS presented on this page may be obtained directly from the publisher mentioned in each case. E&MJ does not sell books.

Shubenacadie and Kennetcook Map Areas, Colchester, Hants and Halifax Counties, Nova Scotia, by I. M. Stevenson. The area covered by this report is south and southeast of Truro. Minerals discussed in the economic geology section include gold, lead, antimony, barite, manganese, coal, gypsum, fire clay, limestone, salt and slate. Published by the Department of Mines & Technical Surveys, Ottawa, Canada. Pp 88 plus maps. Price $1.

Records of the Geological Survey of Tanganyika. Sections of the report cover geologic progress reports and notes, an index map of Tanganyika, economic geology, engineering geology, special investigations for helium and hot springs, geophysics, petrology and mineralogy. Published by the Government Printer, Dar Es Salaam, Tanganyika. Pp 106 plus maps. Price Shs 17/50.

Summary of Silicate Rocks Associated with Carbonate Bodies of Tanganyika, by T. C. James. Pp 2.

The Geological Environment of Copper Deposits in Tanganyika, by J. K. Whittingham. Pp 10.

Annual Review, The Mining Journal. The 1960 edition covers reports on all major metal and non-metallic mineral commodities; worldwide technological progress in exploration, mining, ore treatment and refining; and important activities in all principal mining areas of the world. Progress reports for 150 major mining companies of the Commonwealth are reviewed. Published by THE MINING JOURNAL, 15 Wilson St., London E. C. 2. Pp 368. Price 21 s ($3), post free.

Bibliography of South Australian Geology by E. N. Teesdale-Smith, geologist, South Australian Department of Mines & Geology. This bibliography includes all literature published up to and including June 1958. Transmitted by the South Australian Government Exchanges Bureau, Government Printing Office, Adelaide, South Australia. Pp 240 plus index map.

Summary of the Geology of Tanganyika, Part II, Geological Map. Prepared by the Geological Survey, Ministry of Mines & Commerce, Tanganyika. Printed by the Government Printer, Dar Es Salaam. Price 5 s.

U.S.G.S. Publications

The following publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C. for the prices stipulated:

Annual Report of the Director, Geological Survey to the Secretary of Interior for Fiscal Year Ended June 30, 1959. Pp 119-159. Free on application to the Geological Survey, Washington 25, D.C.

Trilobites of the Upper Cambrian Dunderberg Shale, Eureka District, Nevada, by A. R. Palmer. Professional Paper 334-C. Pp 56 plus illustrations. Price 65c.

Mode of Flow of Saskatchewan Glacier, Alberta, Canada, by M. F. Meier. Professional Paper 351. Pp 70 plus illustrations. Price $1.25.

Geology and Ore Deposits of Northwestern Chichagof Island, Alaska, by D. L. Rossman. Bulletin 1058-E. Pp 77 plus illustrations. Price $1.25.

Some Geologic Features of the Pima Mining District, Pima County, Ariz., by J. R. Cooper. Bulletin 1112-C. Pp 40 plus illustrations. Price $1.

The Foraminiferal Genus Orbitolina in North America, by Raymond C. Douglass. Professional Paper 333. Pp 52 plus illustrations and maps. Price $1.50.

New Publications of the Geological Survey. List 620 includes publications issued in March 1960. Items in this list include book reports, bulletins, professional papers, circulars, maps and charts, geophysical investigations, mineral investigations, and topographic map sheets. U. S. Government Printing Office, Division of Public Documents, Washington 25, D. C. Pp 10.

In this **Split Wedge Gate**

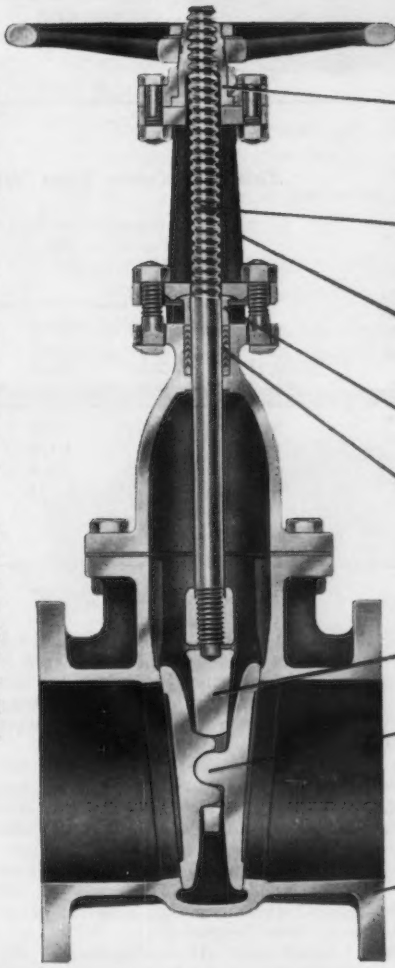
you can see why it pays to

Specify JENKINS for STAINLESS STEEL Valves, too

This picture shows the many points of excellence in the design and construction of Jenkins Fig. 1327 Split Wedge Stainless Steel Gate Valves. Compare them with any valve you know. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves. You'll find in it the patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services. Also, you'll see that these Jenkins valves meet valve industry specifications and the high standards established by the leading users of stainless steel valves. Jenkins Bros., 100 Park Avenue, New York 17.



WHEEL of high strength malleable iron designed for firm grip and easy operation.

YOKE BUSHING, easily renewable. Made of bronze, for ideal thread engagement with stainless steel spindle, to prevent seizing or galling of spindle threads. Bushing of stainless steel is optional.

SPINDLE has long thread bearing surfaces with correct lead for easy, tight closing. Screws into wedge carrier, then secured by a stainless steel pin.

YOKE BONNET has liberal space between yoke arms for easy access to packing box. Precision machined flange face assures uniform contact with gasket for a tight body-bonnet joint.

GLAND consists of two pieces — gland flange and gland follower — eliminates binding of follower in case gland bolts are tightened unevenly.

PACKING of Chevron-type Teflon in large packing box prevents leakage. Only a minimum load is required on gland, extending service life of packing.

WEDGE CARRIER connects wedge to spindle and raises or lowers it. Husky in size to stand any operating strains.

SPLIT WEDGE is the ball-and-socket design which automatically adjusts to the tapered seating surfaces for positive shutoff. The discs, revolving freely in the wedge carrier, produce a self-cleaning action on seating surfaces and reduce possibility of galling and seizing.

BODY —Through-port design for full, free flow. Ample wall thickness and good design provide extra strength to withstand stresses. End flanges conform to M.S.S. specs.

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OPERATING IDEAS

Pipe Mechanism Speeds Turning

A NEW pipe turning mechanism, used in Minnesota taconite operations, has extended the life of tailings pipe and speeded the turning procedure, according to its developer, Lake Shore Inc.

The new device handles lengths up to 1,200 ft at a time. A ratchet fitting, installed to the fork side of a front end loader, attaches to the pipe at the flange with the aid of an alloy pin through a single bolt hole. Since the Lake Shore mechanism is applied at the flange end, two 600-ft sections of 12-in. pipe can be turned in a single operation using a two-man crew.

Another important advantage, the firm says, is that pipes may be turned at one-quarter increments, thus giving users four wearing surfaces.

The device can be adapted to most front end loading equipment and is adjustable to fit a variety of pipe diameters. In one operation, it turned 12 in. pipe weighing about 30 tons per 600-ft of length when loaded with tailings.

Lub Grease on Cable Eases Tension, Cuts Moisture Corrosion

TO EASE TENSION on both hauling rig and cable in pulling phone and power lines through manholes, Paul C. Ziemke, Clinton, Tenn., recommends ample quantities of lubricating grease on the cable.

Increasing the length of cable runs through increasingly long ducts is possible by use of correctly mixed and applied lubricants, Ziemke reports. And this method helps prevent lead corrosion, underground which is a problem when barreled soft soap is applied.

Table of Cable Sizes When Greased in Fibre Ducts

Size of Duct (fibre)	For straight sections less than 300 ft in length		For straight sections 300 ft to 600 ft in length		For curved sections less than 300 ft long, & 1 or 2 bends of 50 to 250-ft radius.	
	Conservative Max. Size	Exceptional Max. Size	Conservative Max. Size	Exceptional Max. Size	Conservative Max. Size	Exceptional Max. Size
3	2-1/2	2-3/4	2-3/8	2-5/8	2-1/4	2-1/2
3-1/2	3	3-1/4	2-7/8	3-1/8	2-3/4	3
4	3-3/8	3-5/8	3-1/2	3-1/8	3-1/8	3-3/8
5	4-1/4	4 1/2	4 1/8	4-3/8	4	4-1/4

Crawler Parking and Digging Hints Given

OPERATING EARTH MOVING EQUIPMENT has developed many tricks to increase equipment efficiency and safety. Two topics aired recently by the service department of International Harvester Co.'s Construction Equipment Div. were approved parking and tough digging techniques.

The recommendation for parking is that if the operator must leave the machine with the engine running, he throttles down to a low idle position. This technique takes the strain off torque converter rigs. Fast engine speeds cause the converter oil to churn, developing intense heat that eventually damages seals and bearings.

When parking a crawler with the engine running, IH says, place the transmission in neutral, engage the clutch and lock the foot brakes. With the clutch engaged neither the pilot bearing nor release sleeve bushings will be rotating, and the cams and clevis pins will be snugged in closely. The friction facing will be tight on the flywheel, transferring heat away from the clutch for less wear and longer clutch life.

Two safety hints for parked crawlers were advanced. Leaving the transmission in neutral prevents the hazard of someone causing a run-away crawler by using the clutch lever as a hand hold in climbing aboard. Lowering the blade, pan or similar equipment all the way to the ground whenever the rig is parked is another safety reminder.

Here's what IH recommends to dig into hardpan or frozen ground on a dozer not designed to angle or tilt. Maneuver a log, rock or block into place under one track near the rear of the tractor. The object must be spotted near the rear to nullify the oscillating effect of the track frame. A corner of the blade now should be low enough to break through the tough material. Once the first cut is made, it's usually a simple matter to open up the rest of the job.

Hot Dip Galvanizing Adds Years to Rails

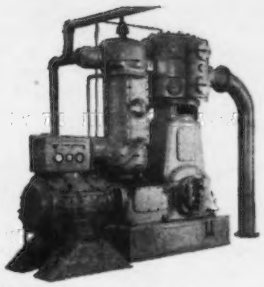
A NUMBER of Dutch mine operators are now getting three times the service life previously experienced with uncoated steel rails by hot-dip galvanizing tracks used to carry heavy ore loads.

Conventional steel rails formerly used in the Dutch mines became corroded and unsafe after two to three years as a result of the constant exposure to water, humidity, and aggressive chemical attack. Since applying a protective zinc coating by hot dip galvanizing, the rails give five to six years of efficient heavy-duty service, according to a report by the American Zinc Institute.

The rails were coated with from 3.2 to 4.0 mils of zinc. Friction wore away the bearing surface of the rails, but this same friction also removed any trace of rust on these surfaces. The area where the galvanizing process really helped was on the sides and base of the rail.

Which... ATLAS COPCO COMPRESSOR

meets your needs best?



AR Heavy-Duty Compressors

More air per horsepower than any comparable compressor! For continuous, full-load operation. "L" angle, 2-stage, double acting. Water cooled. Standard models provide 382 to 3210 cfm free-air delivery at 100 psi; only 76-590 hp required! (Can be supplied for other working pressures on request.)

What's your compressor requirement? Need an installation large enough to provide air for all your needs? Or would a small, compact unit for auxiliary operation solve your immediate problem? Either way—and for a wide range of applications between these extremes—Atlas Copco has the compressor for you!

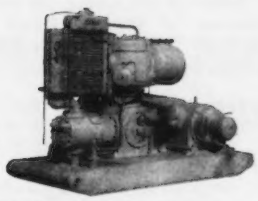
No matter which you choose, you'll get these proven advantages from Atlas Copco:

(1) More air per horsepower—less power consumption than other comparable units!

(2) Really low maintenance (one example — $3.10 after 10,000 hours' operation)!

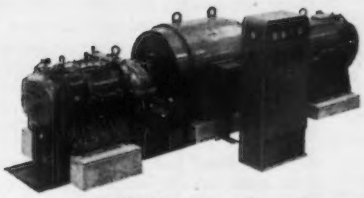
(3) Specifications are guaranteed free-air delivery — you get exactly what you order!

Get all the facts now—and compare! The coupon below will bring you a free catalog. (No obligation, of course.)



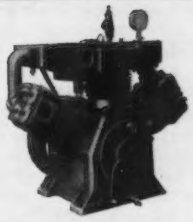
AR-L Heavy-Duty Compressors

Same basic construction as the AR Series, but provided with an air-cooled intercooler and air-cooled radiator for the cylinder water. Fan on compressor flywheel cools radiators. Perfect for arid areas or where difficult to bring in water. Both stationary and skid-mounted models available.



TWIN-AIR Rotary Screw Compressors

Brand new! "Twin-Air" Compressors offer capacities from 6,900 to 19,400 cfm at working pressures up to 115 psi. And, you get completely *oil-free* delivery of air or gas, since no lubrication is required — timing gears maintain small clearances between precision-mounted rotors, eliminating friction (and the necessity of oil) in compression chamber.



CT Air-Cooled Compressors

Stationary, or skid-mounted compressors for use where air demand is between 50 and 300 cfm. Totally air-cooled. Cylinder arrangement designed for smooth, vibration-free operation. Compact, rugged—for continuous, 24-hour trouble-free service. Highly efficient; low on maintenance costs.

ER-6 Heavy-Duty Compressors

New! Fundamental improvements over conventional heavy-duty compressors reduce power requirements (18.3 hp/100 cfm at 100 psi, full load); provide totally enclosed design; and save on floor space. Capacities to 1,140 cfm; standard instruments and safety devices.

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WHAT'S NEW IN PATENTS

OLIVER S. NORTH

U. S. PATENTS

Mining

Design for a rail assembly which enables mechanized loading in mine tunnels advancing into a drift on a curved path. The rails can be laid by untrained personnel. W. M. Hand. U.S. 2,952,411.

An improved method is provided for hydraulically fracturing the mineral stratum between boreholes during the solution mining of trona, salt, potash ores, sulphur, and like soluble salt deposits. C. A. Bays, assigned to Food Machinery & Chemical Corp. U.S. 2,952,449.

Metal and Mineral Processing

A highly efficient frother for use in the froth flotation beneficiation of (1) sulphide ores of lead, zinc, copper, nickel, cobalt and antimony, (2) oxide, carbonate or silicate ores of tungsten, tin and uranium, and (3) salts such as fluorspar and phosphate rock. It is a mixture of a saturated monohydric aliphatic alcohol of medium chain length and butyl, amyl, hexyl or octyl alcohol. Up to 70% less of this reagent is needed, as compared with usual frothers. A. Moeller, assigned to Farbwerke Hoechst A.G. vormals Meister Lucius & Bruning. U.S. 2,950,818.

In an economic modification of the well-known carbonate leach process for treating uranium-bearing ores, consumption of caustic soda is reduced by introducing a preliminary precipitation step, wherein the uranium-bearing solution is mixed with a slurry of calcium carbonate in a sodium carbonate-sodium hydroxide solution. Sodium diuranate is precipitated, and the conditioned uranium slurry is carbonated to form a concentrated pregnant solution containing sodium uranyl tricarbonate complex. F. T. Sherk, assigned to Phillips Petroleum Co. U.S. 2,950,951.

In the production of lead from lead sulphide ore concentrates or the like, the ore is subjected to an oxidation reaction, and the oxidized solids are leached with a basic aqueous solution containing a water-soluble alkylene or alkanol amine or acid salt or derivative thereof, whereby the lead compound is rendered soluble. If precious metals are present, they may be recovered by cyanidation of the residue. F. A. Forward, H. Veltman and A. M. Vissolyi, assigned to Sherritt Gordon Mines Ltd. U.S. 2,950,964.

In the separation of pyrochlore from calcite, apatite and silica, ground ore is pulped and conditioned with Amine 220, Amine 1180, Duomeen T, Rosin Amine D. Acetate or the like, and subjected to froth flotation to float pyrochlore and silica. The float product is cleaned, treated with sodium silicate and methyl isobutyl carbinol, and subjected to froth flotation to float fine mica and sulphides. The pyrochlore-containing sink fraction is magnetically cleaned of magnetite and some ilmenite, conditioned with laurylamine acetate and sodium hexametaphosphate, and subjected to froth flotation to float the pyrochlore away from silica, silicates and coarse mica. H. G. Burke. U.S. 2,951,585.

In a method for producing metallic iron from finely divided magnetite ore, the ore particles are propelled into a flame during treatment and injected into a furnace bath by impingement of the products of combustion on the surface of the bath. Ore is first oxidized at 3500° F to 3600° F, and then subjected to a reducing action to produce metallic iron. P. E. Cavanagh. U.S. 2,951,756.

In the spiral concentration of phosphate ores, an adjustable scoop is positioned in the downwardly flowing stream to cut out certain fractions, especially on the high side, and convey them over the side of the spiral. F. N. Oberg, assigned to International Minerals & Chemical Corp. U.S. 2,952,360.

Copies of U.S. patents can be purchased at 25c each from Commissioner of Patents, Washington 25, D. C.

In a rutile or ilmenite ore chlorination system, iron chloride in dry form is separated by passing the metallic-chloride-containing gases successively through a cooling chamber cooled by the admission of an atomized titanium chloride suspension, a settling chamber for condensing part of the iron chloride, and a washing tower. W. H. Coates, assigned to British Titan Products Co. Ltd. U.S. 2,953,218.

In a fluidized bed process for reducing iron oxide ores by direct contact with a normally gaseous hydrocarbon, the ground ore is admixed with a finely divided dehydrogenation catalyst, such as carrier-supported cobalt molybdate, and the mixture is contacted with the gaseous hydrocarbon at 850° F to 1600° F under fluidizing conditions to reduce the ore to substantially pure iron. P. S. Viles, assigned to Esso Research & Engineering Co. U.S. 2,953,450.

In a commercial process for recovering columbium metal and compounds from columbite ore, slags or concentrates, the source material is opened by caustic fusion with sodium hydroxide or the like or by treatment with sulphuric or hydrofluoric acid. The opened material is leached to remove metal contaminants. The recovered tantalum and columbium acids are contacted with hydrofluoric acid, and the fluocolumbate-containing aqueous phase is separated and treated with a potassium compound to precipitate potassium fluocolumbate, which is filtered, dried and reduced. R. A Foos, assigned to National Distillers & Chemical Corp. U.S. 2,953,453.

CANADIAN PATENTS

Metal and Mineral Processing

Method for recovering metallic oxides and sulphur values from sulphate by-products of the sulphuric acid treatment of ores, e. g. ilmenite ore acid digestion masses, products of other metallurgical operations such as titanium slags from smelters, or iron and steel pickling baths. M. J. Udy, assigned to Strategic-Udy Metallurgical & Chemical Processes Ltd. Aug. 16, 1960. Canadian 603,593.

Method for minimizing the effects of clay-slimes during subsequent beneficiation of sylvinite ore. Crushed high-clay ore is flash heated at 400° F to 1000° F with a direct flame under reducing conditions, whereby the bulk of the clay present is rendered largely non-sliming, when the ore is dissolved in sodium-chloride-saturated mother liquor. W. P. Wilson, assigned to U.S. Borax & Chemical Corp. Aug. 23, 1960. Canadian 604,042.

In the recovery of gold from carbon-containing ores, cyanidation is effected in the presence of an alpha-hydroxynitrile such as crude lactonitrile, dicresyldithiophosphoric anion, or the like. The re-precipitating effect of the carbon is minimized, and the percentage of values recovered is improved. Also, improved recovery is noted even when the process is used with a low-carbon ore that is amenable to ordinary cyanidation. N. Hedley and H. Tabacknick, assigned to American Cyanamid Co. Aug. 23, 1960. Canadian 604,070.

Copies of Canadian patents can be obtained by writing to Commissioner of Patents, Patent & Copyright Office, No. 8 Bldg., Carling Ave., Ottawa.

In the extraction of relatively pure uranium from ore solutions, the solution is passed through a plurality of pumper-decanter extraction stages counter-current to an organic extractant consisting of a solution of tributyl phosphate in hexane. E. G. Schmieding and A. E. Ruehle, assigned to U.S. Atomic Energy Commission. Aug. 30, 1960. Canadian 604,477.

In the recovery of low-calcium-sulphate sylvite, ground sylvinite ore is pulped, and the pulp is acidified to a pH of 3.5 or less with hydrochloric acid, and subjected to froth flotation to float selectively the sylvite particles. C. H. Fuchsman, assigned to Columbia-Southern Chemical Corp. Sept. 6, 1960. Canadian 604,563.

In the recovery of low-calcium-sulphate sylvite, ground sylvinite ore is pulped, and the pulp is treated with sodium hydroxide to obtain a pH of 11 to 12 and subjected to froth flotation to float selectively the calcium sulphate. The residual solution is neutralized and the potassium chloride floated therefrom. J. W. Moore, assigned to Columbia-Southern Chemical Corp. Sept. 6, 1960. Canadian 604,564.

Mr. North is patent consultant, Washington, D.C.

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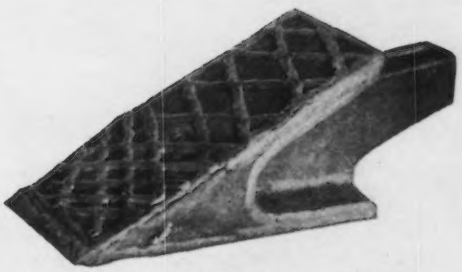

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Highlights of AMC's Show (*Continued*)

Exploration costs and organization formed the basis for an excellent presentation by Karl J. Springer of Mining Exploration & Development Enterprises, Toronto. After a brief history of exploration and the appearance of geophysics, EM aerial surveys, etc., Mr. Springer cited some relatively typical costs.

The Mattagami Syndicate, for instance, surveyed 600 sq miles by airborne geophysical means in five days at a cost of approximately $40,000. (Similar work on the ground would have cost about $500,000 and taken three years, he said.) He estimated follow-up costs (ground crews with technical knowledge and competent supervision and full tactical equipment) at about four times the cost of the aerial survey.

The developer of Mattagami then offered the syndicate scheme as the best working tool to help small mines participate in major exploration. He described the working rules of one such syndicate as follows:

Stage one: Each company named a representative who would have full authority to act for it, and whose decisions would be binding upon it, and each agreed upon monetary contribution to the survey.

Stage two: Upon completion of the survey, the partners decided what funds were available for ground survey and which anomalies warranted such search. Any partner desirous of leaving the syndicate at this stage forfeited all interest.

Stage three: If it was decided to continue with a given project, more funds were provided.

Stage four: If it was decided that a property existed, a company was formed, further financing obtained by sale of stock, and the partners would receive vendor stock for their interest.

In discussing AN mixtures, Donald M. Stromquist of Coal Chemical Sales, U.S. Steel, noted use of ammonium nitrate and fuel oil mixing procedures in many mines where the operators did their own mixing and saved on a premium cost, or obtained even greater savings by purchasing in bulk. In the latter area, he said, one firm unloads from railroad cars via an under-the-track auger to a wooden bin. The bulk-loading truck receives the AN and loads the hole directly while oil is sprayed into the flowing material. Another firm obtains excellent mixtures with two vinyl-lined cement mixtures in less than 10 minutes; and a Nevada firm has so spotted its bins that gravity provides power for most of the movement to the loading site of the truck and "the hole loader is so constructed internally with sloped surfaces that the ammonium nitrate falls again by gravity when desired into an attached measuring container, out of the container against a metered spray of oil and into the borehole." Other innovations cover use of molasses and sugar and water, TNT and other borates and nitrates in various proportions to slurries for densities ranging from 1.4 to 1.7, and unique loading techniques.

The challenge to modern mines, according to Prof. Howard L. Hartman, head of the mining department of the Pennsylvania State University, is to raise its sights in the field of dust control from alleviation of individual hazardous conditions underground to action in the whole broad area of mine air conditioning; that is, to go beyond mere ventilation to control of quantity, quality and temperature-humidity of air.

In a well-documented study of gases, liquid particulates and dusts, Prof. Hartman called for stringent control measures against all dusts, even those now considered only nuisance dusts, and offered a number of principles of mine dust control. He offered particular encouragement to programs which prevent dust from becoming air-borne in the first place—"Once the solid contaminant becomes airborne, the control task becomes immeasurably more difficult and costly."

A Koepe hoist installation at the Bristol mine of Inland Steel Co. which will permit the iron mining company to sink its shaft from the 1650 level to 1900, and even another 250 ft in the future was described by James R. Gronseth, mechanical engineer of Inland's iron mining department. Conversion from single drum hoists to friction hoisting presented numerous problems, including a significant change in rope size, a switch from Kimberley-type skips to bottom dump skips, compensation for the shaft having gone out of plumb because of subsidence, increase of total suspended load, galvanization of hoist ropes to prevent corrosion since grease would cut friction, and hence, efficiency, introduction of "PVC" material on the drum. Other minor corrections had to be made once the system was in operation, including a number of electrical relays and interlocks.

But the desired effects were accomplished: The converted Bristol system now reaches 250 ft deeper and hoisting capacity has increased some 35%, the speaker said. "The increased loads on the hoists and headframe were handled with minor reinforcing and the misaligned shaft has not presented any tail rope problems."

"It's a good place to work, it's clean, safe, efficient, and it's profitable." With that exciting summary, J. Gordon Craig, mill superintendent of the Lucky Friday mill, wound up a comprehensive report on the construction of Hecla Mining Co.'s new plant near Mullan.

The mill and surface plant are striking evidence of what can be accomplish-

(*Continued on p 123*)

KUNO DOERR, JR., president of Southern Peru Copper Corp. at Toquepala, died Oct. 13 at Lima, Peru. Mr. Doerr spent his entire business career with Asarco and was manager of the Garfield smelter when he received appointment to the Toquepala project in 1958.

Hack Plans 500-tpd Plant For Schroeckingerite

AN AMAZINGLY SIMPLE process for producing yellow cake, and one which will perform at about one-half the present costs of Western uranium mills has been designed by Al Hack, president of Hack Engineering Co., Denver.

In a plant which the firm will build for Lucky June Mining Co. near Rawlins, Wyo., schroeckingerite ore will be crushed to minus ¼-in. in jaw crushers and a pug mill, screened, agitated for about two hours with the reagent, decanted and thickened. The Lucky June plant was first outlined as a 150-tpd operation, but may be increased to 500 tpd if current negotiations are successful.

The Hack reagent, which costs less than 20¢ per ton of ore processed, requires no stainless steel or rubber-lined equipment to produce a 70- to 80% yellow cake from the 0.6- to 0.7% ore. The process has not been applied to other than schroeckingerite ores.

Colorado "Mines" Panel Studies Drilling, Firing

THE TENTH Annual Drilling & Blasting Symposium, held late last month under the auspices of the University of Minnesota, Pennsylvania State University and the Colorado School of Mines, at Golden introduced a number of trends in mine art and practice.

Future issues of E&MJ will present detailed discussions of some of the highlights of the meeting, including: the trend toward smaller (and inclined) blast holes for open pits; improved mixtures and techniques in AN use; studies of down-the-hole and rotary percussion drilling.

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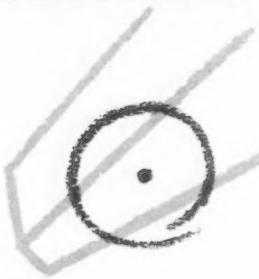

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ed by wise management, intelligent design engineers and a dedicated work force in a relatively small mining company. The 400-tpd plant, which can be expanded to 700-tpd, was erected in less than nine months "for less than $1,000 per ton-day" by a crew which had little or no experience in mill construction but had a will to do the best job possible.

The present plant is a model of careful use of process controls, intelligent layout of equipment and materials handling aids, and judicious simplicity in flowsheet design. From the ground up the Lucky Friday crew sought and found cost-cutting techniques which incorporated process safeguards.

Another raise climber, the Joy-Craig raise machine, has been introduced to American mining. Designed to eliminate timbering while driving a raise, it is easily transported and installed and its use speeds the safe movement of men and materials to and from the working face in the raise, according to Joy Mfg. Co. (Canada) Ltd.

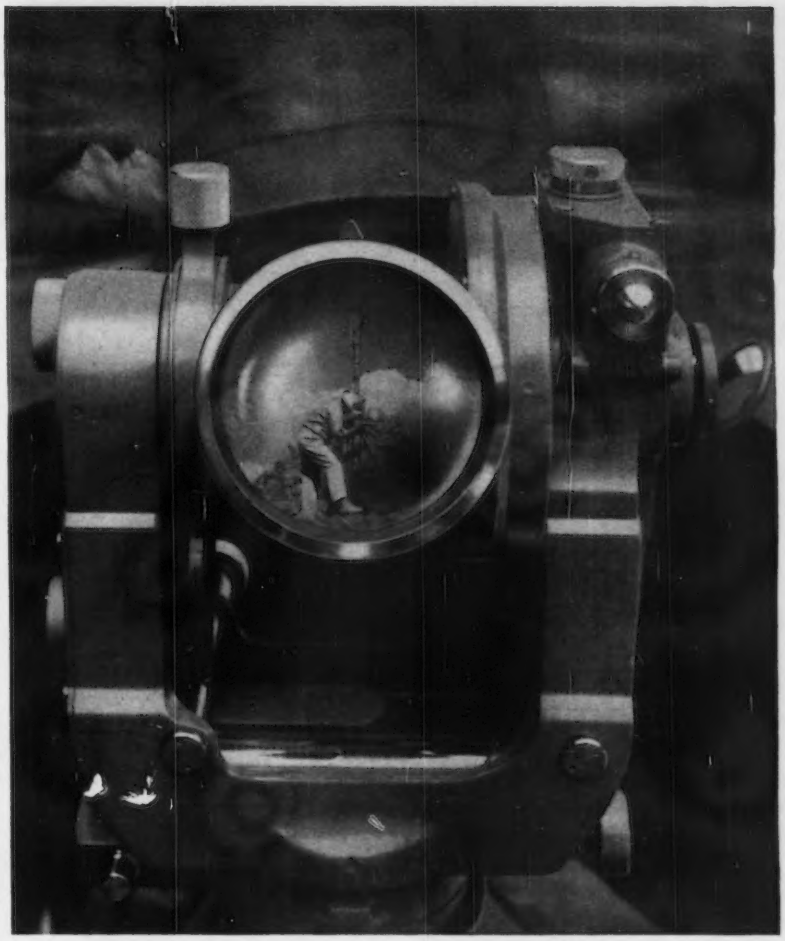
A truck-mounted, or stationary, combination crusher-pulverizer-concentrator, powered by gasoline or electricity, was introduced by Shelton-Cheney Mining Co. Weighing only 2,000 lb and operating in closed circuit, the machine can handle any type of ore, the company claims.

A portable concrete guniting rig designed for mines and tunnels was featured by Ridley & Co. Inc. Air-powered and mine-crew operated, the underground rig shoots 6 to 12 tph. The company claims it gives mine operators an inexpensive method of reinforcement that eliminates about half the normal bolting and timbering.

The iron ore tax burden in Minnesota, and its restrictive effect upon iron mining, was discussed by C. F. Beukema, president of U. S. Steel's Oliver Iron Mining Div., Duluth. In a general discussion of modern marketing problems and the competition of foreign high grade ores, Mr. Beukema noted that in 1960 OIM paid the largest Minnesota ad valorem tax in its history, at a time when the remaining reserves as they occur were of limited and even questionable marketable value, and known reserves were lowest in the division's history.

The veteran iron ore leader also addressed himself to the imposition of tariffs upon iron ore, and noted that it was unwise to look at iron ore as separate from the steel industry. His final plea was for "statesmen-politicians" to avoid confiscatory and punitive measures which will harm the industry in the long run at the cost of a short-term benefit.

The need for careful advanced planning of facilities for open pit operation was cited by Charles L. Boise, assistant superintendent, Isbell Construction Co., Sahuarita, Ariz. In particular the speaker asked for consideration of the place-



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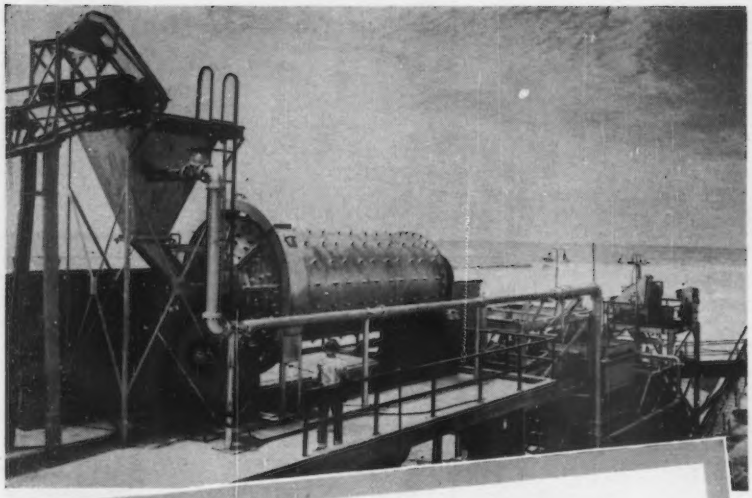

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AMC (*Continued*)

ment of maintenance and repair shops as close to the perimeter of the pit as possible. He also noted that, while pit operation demanded that some installation of power and water line be permanent, savings in time and labor costs could be had by the placement of as much permanent lines as good advance planning would permit.

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Salt Lake Meeting Scans Exploration Problems

JAMES BOYD, president of Copper Range Co., and chairman of the exploration symposium at the Rocky Mountain Minerals Conference, Salt Lake City, Oct. 5, 6 and 7, complimented speakers on the unusual amount of "confidential information" which companies allowed their representatives to give out at the meeting.

Sidney S. Goodwin, vice president New Jersey Zinc Co., said that his company had spent $12½-million over an 11-year period to find 1½-million tons of zinc—an exploration cost of 0.4c per lb of zinc discovered. Company objectives are to discover at least a pound of zinc for every pound mined. This will require an exploration outlay of about $2-million per year. This does not include cost of acquiring property.

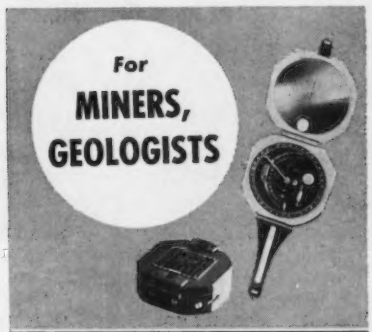
Ten major points which an engineer has to consider to appraise an exploration venture were listed as follows by Frank Cameron, president of St. Joseph Lead Co.:

1. What are the geologic probabilities of the property in question?
2. What are the mining and metallurgical requirements to effect a marketable product?
3. What will be the investment requirements to: (a) prove up the deposit, and (b) develop and equip for operation?
4. What tax liability will the company be subject to?
5. Will the product be competitive marketwise at the assumed cost of production?
6. What is the potential labor supply, and what will the requirements be for housing, etc?
7. What will be the cost and availability of power?

8. What if any transportation problems are involved.?
9. What will be the political climate in which one will have to operate, and what will be the legal status of the proposed new operation?
10. What is the time required to return the investment at the assumed rate of production and with the assumed cost?

Several times during the session, the impact of Cuba's expropriation action was referred to. Cameron said that Canada "offers probably the most favorable tax climate in the Western Hemisphere." Charles Houston, president of C.C. Houston and Associates, of Canada, said that the most favorable place for foreign investment "is in countries where people wear overcoats, and Canada qualifies at least 75% of the time." He said that Canada offers a most fertile field for exploration because of the common language and legal concepts, the stable government, non-punitive tax climate, favorable geologic climate, people who are sympathetic to mining and the shortage of funds.

C. P. Pollock, exploration manager, American Smelting & Refining Co., outlined the steps required to bring the Toquepala project of Southern Peru Mining Corp. into production from the initial exploration phase. Approximately $10-million was required to complete exploration and drilling work. Major expenditures comprising the $237-million venture included $30-million for mill and shops, $20-million for the smelter, $38-



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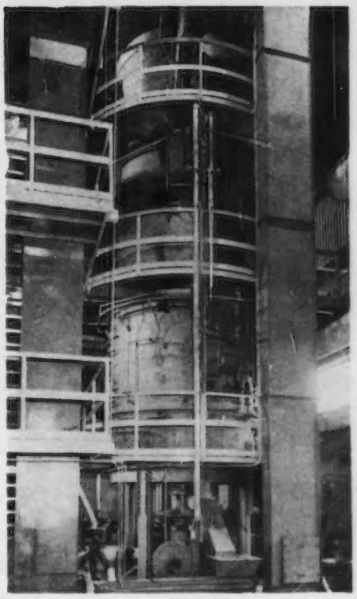

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Rocky Mt. (*Continued*)

million for the 44,000-kw power station and transmission line, $4-million for a 600-ft pier, $24-million for townsites, and $34-million for the 127-mile railroad.

Technical sessions on mining and mineral processing included a report on recent performance data of the Anaconda-Le Tourneau trolley-powered, electric wheel truck by E. R. Borcherdt, mining consultant. This unit, powered by four 400-hp, 600-v dc motors, now hauls up to 75 tons up adverse grades up to 15% at 12 mph, or twice the speed possible for conventional diesel haulage. Thus it is possible, Borcherdt said, to "make a pit conform more nearly to the shape of the orebody with haulage laid out on straight lines and heavy grades instead of the present lighter grade spiralling egress roads which add immeasurably to stripping ratios. He said that Anaconda is now considering the electric wheel for open-pit operations at Cananea, Mexico, and at Chuquicamata, Chile.

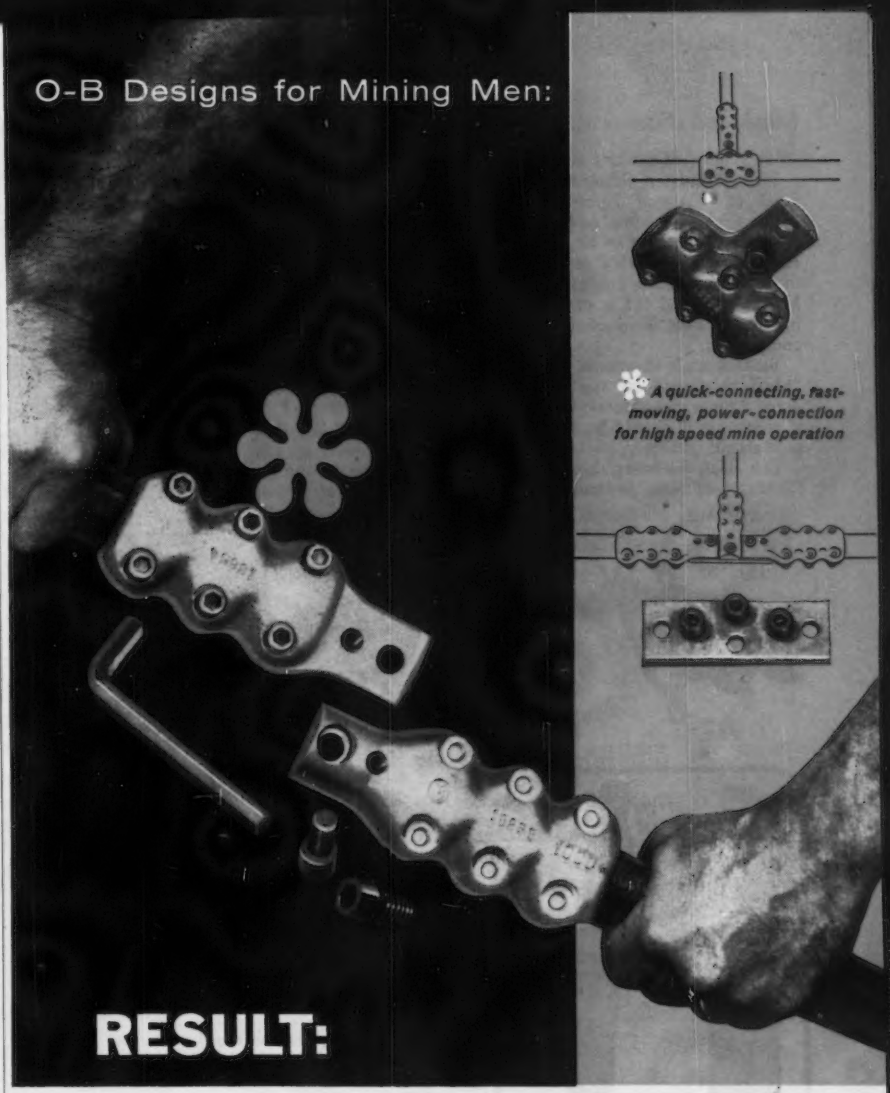
Applications of bacterial leaching of metals from waste dumps were summarized in a paper by E. E. Maloug, J. D. Prater, and A. W. Last, of Kennecott Research Center, Salt Lake City. Charts showed that the rate of extraction of metals from bacteria inoculated samples was much higher than for sterile samples. In one 240-day leaching test of copper from chalcopyrite, extraction from sterile samples was 18%, from inoculated samples, 58%. Similarly, in one 250-day leaching test of zinc from samples containing sphalerite plus pyrite, extraction from the sterile sample was about 0.1 gram of zinc, extraction from an inoculated sample was about 3 grams.

Phosphorite nodules, containing about 29% P_2O_5, can be mined and delivered to California markets for a total cost of $5 per ton from offshore sea deposits as compared with a $15 per ton current market price, according to L. E. Shaffer, professor of mining, University of California. Shaffer attributed the formation of manganese—nickel—copper—cobalt nodules and the phosphorites in sea-floor deposits to "complex ion-exchange processes in sea water where during centuries of time hydrous metal ions precipitated and built up around debris on the sea floor—such as shark teeth and grains of calcareous material."

More and More Mines Fear "Mexicanization"

THERE HAS BEEN TALK among government and private circles in Mexico for several months about "Mexicanization" of Mexican mining. Recently, three news items had the mining trade buzzing again about the trend in Mexico to "Mexicanize almost everything big."

The news made foreign mining companies more jumpy than usual because it came on the heels of the highly publicized take-over of a foreign electric utility by the Mexican government as the last step toward putting almost all electric production and sales in the coun-



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Mexicanization (*Continued*)

try in federal hands and domestic control.

First, Minister Eduardo Bustamante, head of National Patrimony Ministry, announced a possible new law to make it easier for mining to be done by Mexicans. It will probably give tax benefits to those companies having 51% or more Mexican capital (85% of Mexican mining production is in control of foreign companies).

Bustamante's statement pointed to the "Mexicanization" of the Peñoles company (American Metals-Climax) which if reorganized, would be 51% owned by a Mexican group.

The deal, however, hinges on certain "concessions" the government will give the company once it is officially in Mexican hands. The company will agree to process more and more minerals in Mexico (lead and zinc) and, if the deal goes through without a hitch, the company will build an $11.2-million zinc mill in Saltillo, Coahuila.

If the new law puts more pressure on foreign companies by making an even bigger spread between subsidies and tax rebates for Mexican companies and foreign-controlled companies, the foreigners will either have to take on Mexican partners on a 51% basis or face a slow "freeze." There has been talk of the new law (but nothing in writing yet) since last spring.

One of the problems has been to get any local private Mexican investor to go into mining. The government will have to give healthy tax cuts in exports and other benefits to get any Mexicans into the act. Apparently this has been promised. The Mexican backers involved in the Peñoles deal would not have considered it if there hadn't been some "inducement."

Besides the news of the electricity take-over, Bustamante's speech and the Peñoles deal, there were published rumors of a possible government take-over of the old Fresnillo Co. (part of the Mexican Corp., which is a subsidiary of Goldfield Development Co., New York). According to a company representative in Mexico City, the rumors were energetically denied.

Even so, the mining trade was wondering about Fresnillo. The company has had to rely heavily on government subsidy because it has to go deeper and deeper as its ore is scraped out at points near the surface.

The company had a plan in progress to put a much deeper shaft, several thousand feet, to get back into the ore vein. According to reports in Mexico City, costs for this and mining in general for Fresnillo have gone up steadily and the grade of the ore has slipped.

The government, after World War II, was faced with a similar situation when the Real del Monte Co. in Pachuca was faced with a shutdown because of rising costs and dropping minerals prices. The town depended on the mine for its livelihood, so the government negotiated to buy it out.

But the "Mexicanization" of Mexican mining, according to Jose Campillo, head of the Mexican Mining Chamber, does not mean "socialization." It means, he said, an effort to make mining interesting enough to local investors so that they can buy into the foreign companies via partnerships. The government's entry into mining in the past, as was shown in the Real Del Monte case, was done as a last resort to keep local workers and even whole towns from suddenly being cut off from all income.

The case for Mexican mining (mostly metallic minerals, non metallics such as sulphur and fluorspar have been doing reasonably well) is a serious one. Rising costs and dropping world prices have put the squeeze on the big exporters. Many small operators haven't been able to keep up.

The government has been taking a tax on all mineral products shipped out, partly as a good income earner and partly as a safeguard against depletion. The margin for profit and the gloomy world market picture has kept Mexican investors away from mining. Now, it is hoped local capital can be pulled in by tax breaks.

Venezuela Tightens Minerals Policy

INCREASING RESTRICTIONS on private mining activity in Venezuela are reflected in a declaration on minerals policy released by the Minister of Mines & Hydrocarbons, Juan Pablo Perez Alfonzo.

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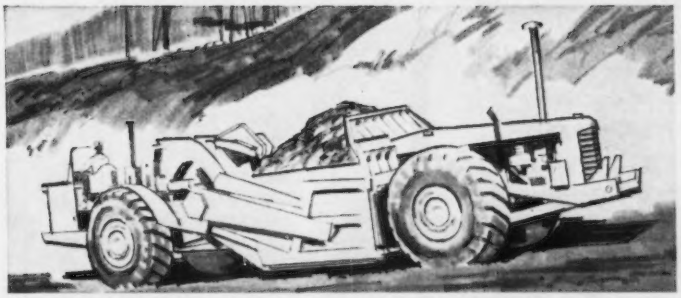

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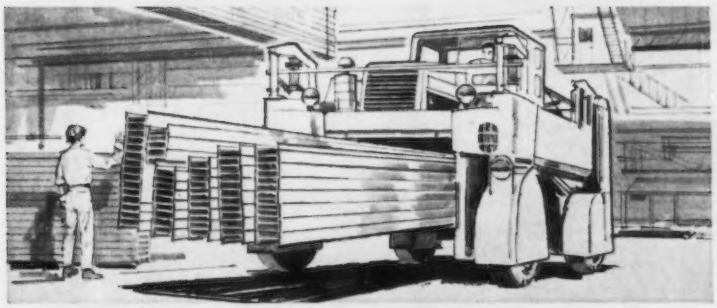

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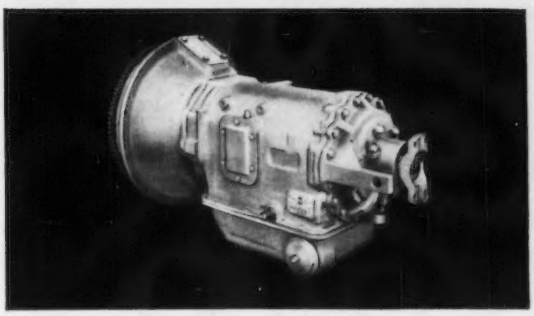

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Venezuela *(Continued)*

The declaration, which is the most comprehensive statement of official mining policy to date, warns that concession holders run the risk of losing their rights in case of failure to comply strictly with legal dispositions. This statement comes on the heels of concessions concellations effecting M. A. Hanna Co., Republic Steel Corp., and International Nickel Co.

Perez Alfonzo also announced that his government is considering a change in the mining law that would award a "premium" to mineral prospectors, instead of the right to develop their claims. No further details on the proposal were made public.

What was made clear by the minister is the Venezuelan policy that "the subsurface mineral wealth is the common property of the Venezuelan people, who have an inalienable right to it. Concessions for the exploitation of hydrocarbons or minerals provide limited rights, over which the eminent domain of the state remains in permanent vigilance."

Here are highlights of the Government's get-tough policy:

1. Venezuela will grant no more iron ore concessions. "And it will take care to recover from private interests who are careless of their rights, those concessions which are in effect and which do not comply strictly with legal provisions."

2. The official policy of producing iron ore within Venezuela in the future "implies a consequent policy with respect to other minerals such as nickel and manganese which are of interest in the production of steel." Concessions will not be granted for these minerals either, and those in effect will get the same close surveillance aimed at iron ore.

3. Bauxite concessions will cease also. In this case, the reason is not because of the existence of proved reserves, but in the country's hydroelectric potential on which the state would base any exploitation of the mineral.

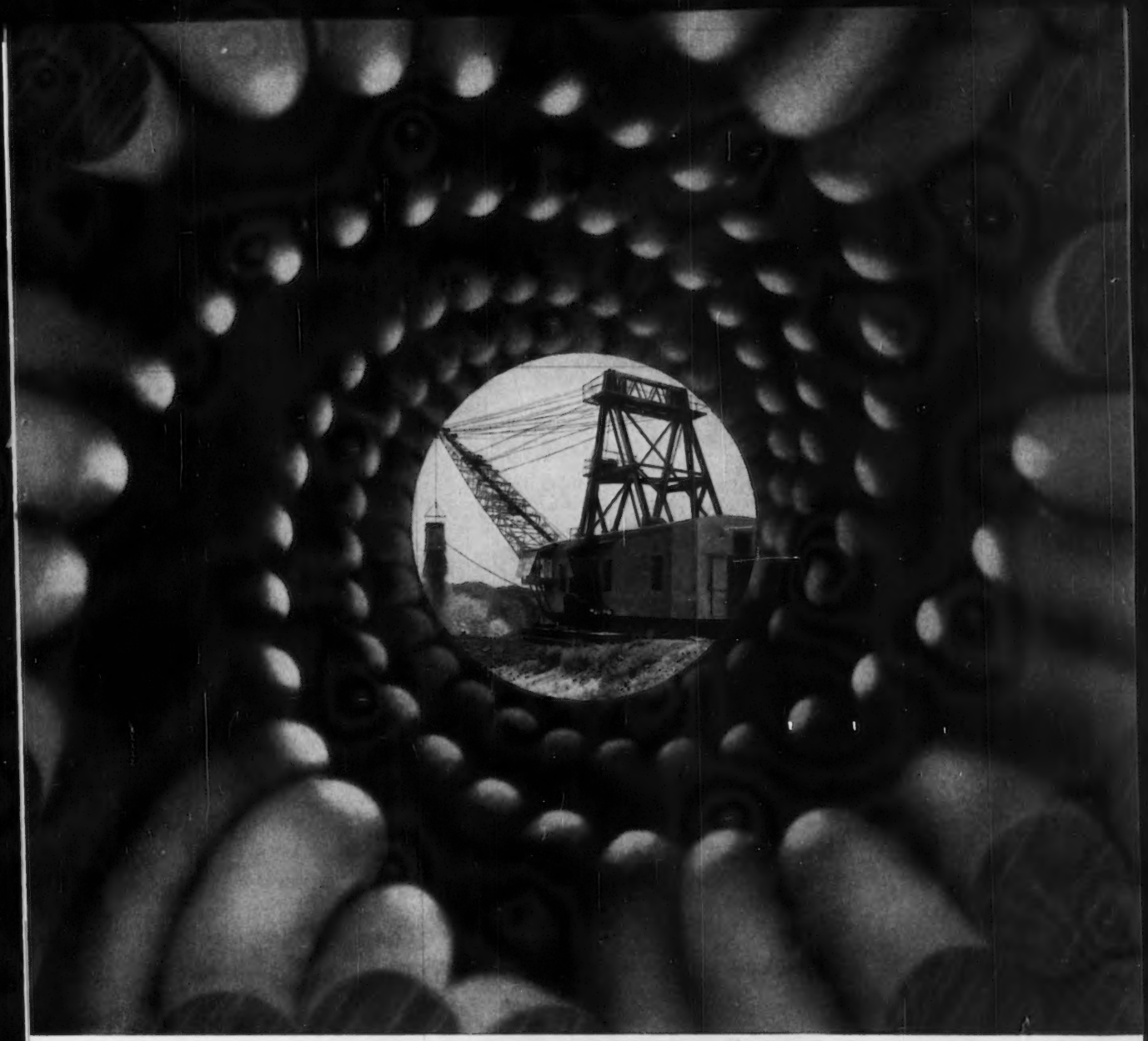
4. Venezuela will not grant concessions on geothermal potential established in the El Pilar region of Sucre State. The government plans to use natural steam in the area for generating electric power.

Fletcher Calls For Lead-Zinc Tariffs

ANDREW FLETCHER, chairman, St. Joseph Lead Co., has proposed replacing the fixed-quota system on lead-zinc imports with a tariff system "until such time as consumption outside the U.S. catches up with production."

Speaking before the regional convention of the St. Louis Society of Financial Analysts, Fletcher summarized the political problems of the industry with comments on the Paley Report.

"In their report, published in 1952, this group developed conclusions to include, among other things, that the U.S. was rapidly becoming a have-not nation in lead and zinc, and that foreign sources of metals should be encouraged ener-



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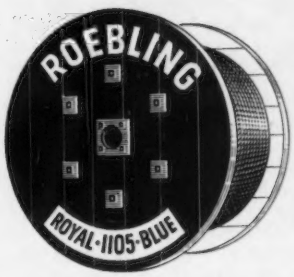

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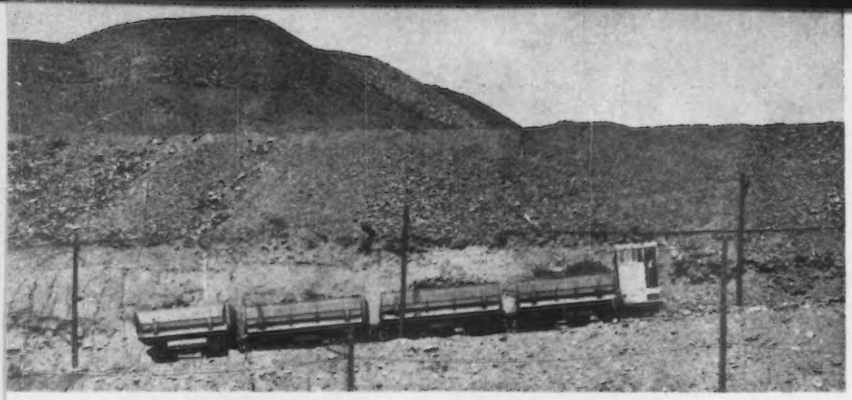

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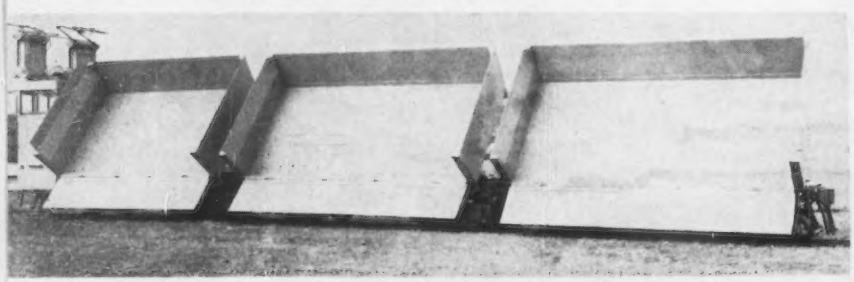

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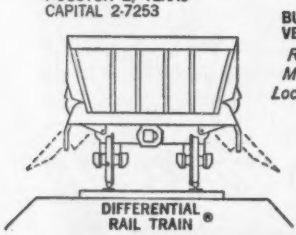

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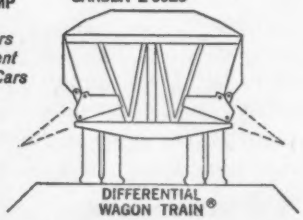

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Fletcher *(Continued)*

getically. The first idea has since been questioned, for example, by our own discoveries of substantial lead orebodies here in Missouri. The second idea has proved harmful in that the encouragement to foreign producers has resulted in repeated floods of surplus lead and zinc from abroad that in recent years have depressed U.S. metal markets and closed many domestic lead and zinc mines.

"Lead and zinc can be produced more cheaply outside the U.S. than inside. This fact of life arises not so much from low foreign wage scales as from the richer orebodies available to foreign producers. In Australia, for example, a ton of ore from the Broken Hill area will yield about ten times as much lead and zinc metal as will a ton of ore from St. Joe's mines in Southeast Missouri. Actually, our mining costs in terms of dollars per ton of ore compare favorably with theirs, but in terms of dollars per ton of metal produced, their higher grade ore gives them a powerful competitive advantage, even though their transport expense to the U.S. markets is high."

"With this built-in cost advantage, and under the stimulus furnished by the Paley Commission's report, foreign producers increased production and sold their surplus metal in the U.S., the most favorable world market open to them."

Commenting on the quota system, Fletcher said, "If it were possible to adopt a flexible quota program, it would give the domestic industry reasonable protection, but no one has yet been able to make a fixed quota system work satisfactorily.

"In our opinion, a proper system of tariffs on lead and zinc imports could be devised that would solve the problem most equitably."

British Columbia Changes Iron Ore Royalty System

POSSIBLE $30-MILLION INVESTMENT and the creation of nearly 2,000 jobs could result from a recently-signed British Columbia order-in-council which revises the reserve and royalty system on iron ore, according to Charles Mitchell, Secretary of the Mining Association of British Columbia.

First change is the removal of the "50% reserve," which stated that 50% of ore in a property belonged to the government and had to be left in the ground—applied to claims held by location or lease, though not to crown granted claims.

"The rule doubled a company's development costs. If you blocked out a million tons of ore and spent $1-million, but had to leave half in the ground, it meant your cost was $2 a ton instead of $1 a ton", Mitchell explained.

The second change is the basis of computing royalties. This is based on $1 per ton of iron contained in the ore. However, the ore will now be deemed to contain 50% iron, even though it must be

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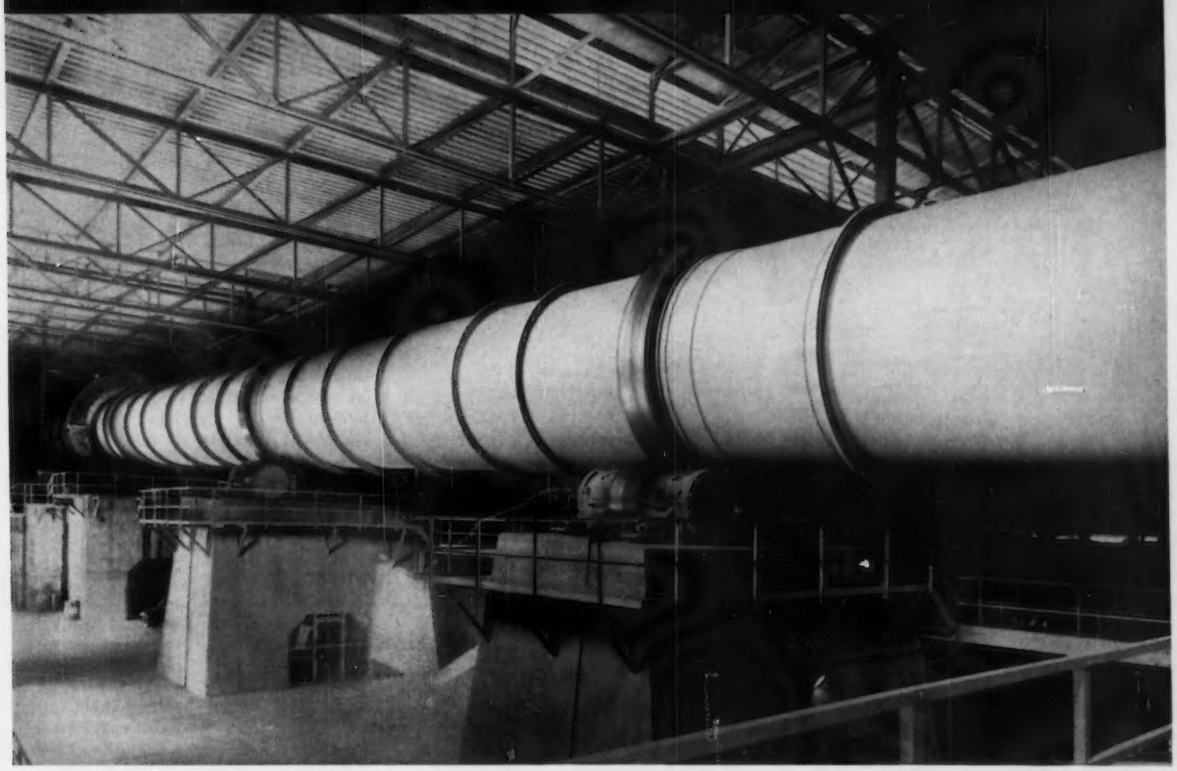
efficiency built into this rotary kiln



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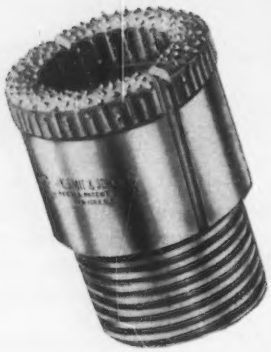

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B. C. Iron (*Continued*)

concentrated to around 64% to be marketable. It will also be paid on the basis of a long ton of 2,240 lb instead of a short ton of 2,000 lb. In addition, half the royalty will be rebated to help find new ore deposits and build reserves.

The new formula reduces the average royalty to about 23c per short ton and will help to make the B.C. output competitive with ore from Malaya, South America and the Philippines.

The cabinet's decision cancels two previous orders. One asserted government ownership of half the ore, and the other put a reserve on the staking of claims. Purpose of the restrictions was to conserve iron ore for possible creation of a B.C. steel industry, which is now assured. Consolidated Mining & Smelting Co. is building a steel mill to use the tailings from its Sullivan mine.

IN THE U.S.

ALASKA

The Alaska State Div. of Lands and Div. of Mines & Minerals will hold joint public hearings in five cities during the month on proposed State mining regulations. Reason for the hearings is to get the views and opinions of miners, prospectors, and other interested persons on regulations that will govern mining rights and mining leases on State-owned land.

ARIZONA

Old Nevada Mining Corp. has sold three copper-gold mines, 20 miles southwest of Aguila, to a group of investors headed by Philip J. Allor of Las Vegas, Nev. Cost of the deal, which included the Copper Star, Blue Sahara, and Horseshoe mines, was $200,000.

CALIFORNIA

A syndicate of local buyers has purchased the New Almaden Mines near San Jose for an undisclosed sum well in the millions. One of the country's most prolific sources of quicksilver, the mines produce an average of 1,000 flasks annually. Since 1846 more than 1.1-million flasks of mercury have come from the property.

COLORADO

Don H. Peaker, president and treasurer of U.S. Beryllium Corp., said at an annual stockholders meeting that his company "has more commercial grade beryllium ore mined, stockpiled and blocked-out underground than any other beryllium mining operation in the U.S." He revealed that Beryllium Corp. has leased the old Red Skin Mine, a former gold and silver operation northeast of the

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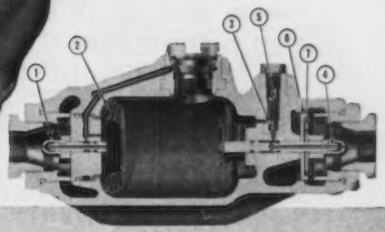
(1) Inlet reed valve meters air into the oil-resistant bellows (2) which creates pressure that forces regulated amount of oil through porting connected to the needle valve (3) and the porting connecting it to the outlet reed valve (4) through which oil is injected into the air stream.

(5) Set screw permits easy external adjustment of oil feed during operation.

(6) Positive pressure differential valve assures correct oil feed for all air flows — eliminates oil waste.

(7) Shut-off valve automatically stops air when oiler is empty. As oil supply goes down, bellows (2) expand and contact the shut-off plunger, depressing it until the valve reaches the automatic shut-off position.



That's right! *You'll never burn out an air tool with the new Le Roi LO-380 on the job!* When the oiler runs dry, it automatically shuts off the air! The "no oil — no air" design prevents unnecessary wear on critical parts — cuts repair bills — extends tool life!

The new line oiler assures positive lubrication for air tools — delivers a steady mist of oil at 10 to 150 psi — and keeps it flowing until you shut the air off, or until the empty oiler shuts it off automatically. Metered oil flow provides exceptional economy, prevents oil splurges. As a matter of fact, the LO-380 will pay for itself in a short time through oil savings alone!

Oiler permits easy external adjustment of oil feed — provides full one-pint capacity. Lightweight — only 9 lbs. — it's easy to use, easy to move—operates in any position. Oiler can be refilled under pressure while air tool is in operation.

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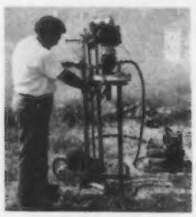
First of its kind with "big rig" rotary drive for fast, economical subsurface exploration and production drilling in soils, rock and concrete. Precision engineered of tough, high-tensile alloys for lightweight strength, easy handling and all around utility.

READY FOR ACTION ANYTIME . . . ANYWHERE!

- Pre-bid drilling*
- Borrow exploration*
- Dewatering*
- Minerals prospecting*
- Post holes
- Horizontal boring*
- Foundation testing
- Concrete drilling
- Handles standard sampling and testing tools.

Versatile MINUTEMAN handles augers from 3″ to 12″ in diameter; drives 6″ diameter augers to 30′ depths. Total price for MINUTEMAN Basic Auger Package . . . complete with all tools needed to auger 3″ diameter holes 25′ deep and handle jobs marked (*) above . . . only $1,485 F.O.B. Indianapolis.



◀ **When equipped for core drilling,** the MINUTEMAN drives EW core barrels to 200′.

When equipped for concrete drilling, the MINUTEMAN extracts cores from 1″ to 8″ in diameter. ▶

MINUTEMAN features include: 6.5 HP engine • Twin shafts, 8-speeds • Diaphragm carburetor for any-angle drilling • Power or manual feed both in and out of hole • 44″ continuous stroke • Wheel mount • Lock Grip vertical or horizontal anchoring • Easily adapted for truck or trailer mounting.

MINUTEMAN 4-page brochure gives specifications, tool options and operating features. Write today for your copy . . .

MOBILE DRILL®

MOBILE DRILLING, INC.
Dept. 35 • 960 North Pennsylvania Street
Indianapolis 4, Indiana, U. S. A.

Colorado (*Continued*)

firm's present Boomer Mine holding in an effort to increase mining potential.

DELAWARE

Bestwall Gypsum Co. has begun construction on a $7.5-million plant at the Wilmington Marine Terminal, inaugurating the company's first manufacturing installation on the mid-Atlantic coast.

IDAHO

The Lexington Silver-Lead Mines, Inc., has reopened a 1,000-ft tunnel at its Hibernia property near Mullan, Idaho, to explore a lead-silver showing.

A report by the Idaho Bureau of Mines and Geology and the University of Idaho College of Mines indicates that Idaho has large reserves of thorium. The report, based on studies carried out by the bureau during the past few years, points out that Idaho's thorium is mostly in thorite, instead of monazite, the mineral from which most thorium has been produced.

Principal sources of thorite are at Hall mountain in Boundary County and the Lemhi Pass area. Northwest Prospecting and Development Co., Spokane, has leased the old Golden Sceptre mine on Hall mountain where first discoveries were made in 1955. The bureau's report indicates that experiments with ore from the Hall Mountain area show that a marketable product can be obtained by economical gravity concentration methods. The report said that flotation and hydraulic classification tests of the Lemhi Pass ore did not yield satisfactory recoveries.

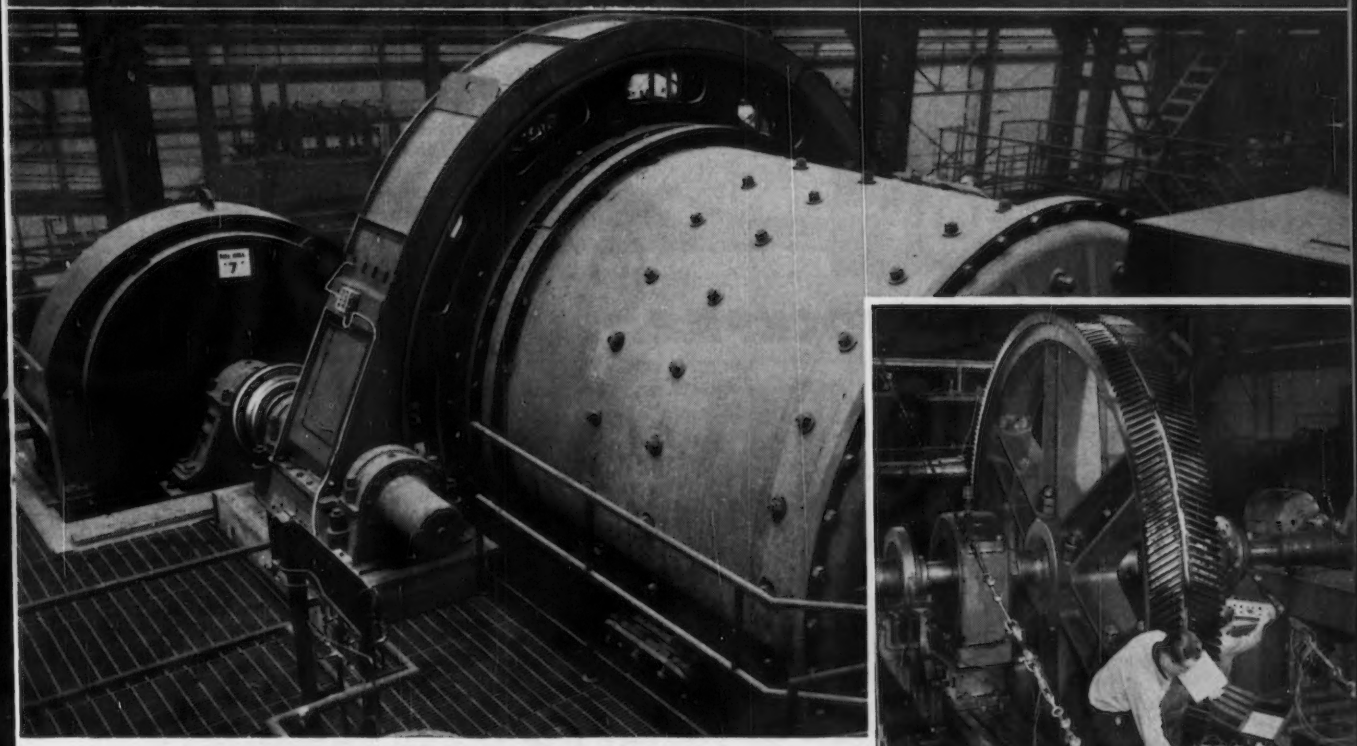
A landmark of northern Idaho, the old compressor of the American Smelting & Refining Co.'s Morning mine at Mullan, has disappeared in the dismantling and razing of the structure this fall. It once housed the largest water wheel ever built and was used to supply air for the mile-deep workings of the Morning mine. The compressor building was erected in 1900.

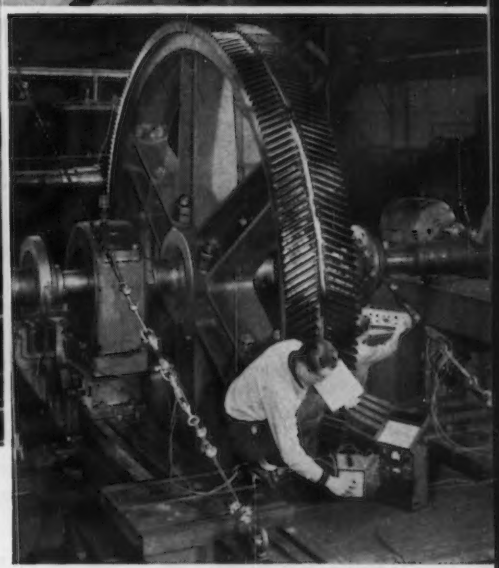
Beryllium International Inc. has acquired an option on the 13 original discovery claims of Kenneth Liddiard, Idaho prospector who made the recent beryllium discovery in the Sawtooth Mountain area. (E&MJ, Oct. 1960, p. 158.) The company plans immediate work at the site to determine the extent of the discovery and the possible extent of the granite in which the aquamarine preferentially occurs.

MICHIGAN

The Michigan Tax Commission has granted Pickands—Mather Co. reductions totaling $1,725,000 in assessed values of its mining properties in Gogebic County. The commission said its investigation in the area "revealed some glaring discrepancies of assessed valuations, which in-

HELICAL GEARING BY **FALK** ...FOR MILLS AND HOISTS





Falk Gears are *the Most Efficient* you can buy...

and are the most economical in the long run!

These are broad claims—but they have been proved beyond question by countless laboratory tests and confirmed by the actual experience of leading mill and hoist operators and engineers.

Falk ring gears transfer the gear tooth load directly to the shell flange of mill or hoist. They are correctly designed and of rugged proportions for maximum rigidity and accuracy. These helical gears—with extra-depth, extra-capacity teeth—provide a single-mesh, high reduction ratio drive giving you these advantages:

- Gear efficiency of 98+% (see column at right)
- High motor speeds—hence saving in motor and power costs
- Smooth helical gear action
- Maximum resistance against abrasive wear
- Longer service life of gears and of driving and driven machinery

This all adds up to the highest efficiency and greatest over-all economy. Don't compromise with quality on your gearing. *Insist upon Helical Gears by FALK*—the country's pioneer and leading supplier of precision gearing.

Consult any Falk representative—also, write for **Engineering Report 6170,** "Advantages of Helical Gearing."

THE FALK CORPORATION, 3001 W. CANAL ST., MILWAUKEE 1, WISCONSIN

GEAR EFFICIENCY PROVED BY SPECIAL LABORATORY TESTS

In the Falk Mechanical Test Laboratory, continual full-load tests of helical gears and gear units are conducted to provide accurate data on gear efficiency, capacity and lubrication.

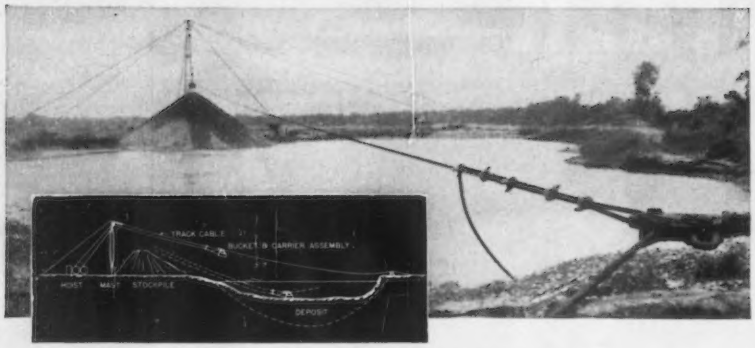
The above photo shows the use of special testing equipment to obtain data on mechanical efficiencies of Falk helical gears. Tooth pressures corresponding to rated capacity and speed are applied through a loading device equipped with strain gauges for accurate load measurement. Power losses are determined by an accurately calibrated torque meter on the connecting shaft of the motor.

Test data show the average tooth-mesh loss for a single-reduction set of Falk Helical Gears is *less than* 1½% of the rated capacity. Thus, the efficiency of the gears is 98½% *or greater*—proof that Falk Helical Gearing is the most efficient obtainable.

FALK is a registered trademark

FALK

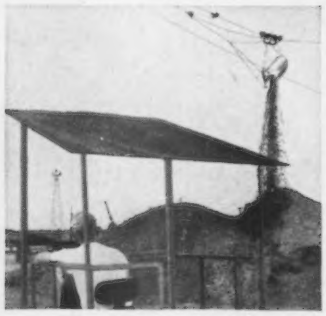
...a good name in industry



FROM PIT TO STOCKPILE...

DIG and HAUL for 8¢ per yd.

WITH A SAUERMAN SLACKLINE



Operating costs as low as 8¢ per yd. for labor, power and maintenance are reported by Slackline Cableway owners when digging free-caving material at average depth and haul distances.

These low costs are achieved by using just one machine—the new Sauerman Slackline Cableway. Multiple equipment is not needed to supply your required tonnage. For example, on an average haul and digging depth, a single medium size machine will charge a 200 tph. plant.

The high Slackline mast permits building a large pile which can supply plant demands through a plate feeder and tunnel conveyor, front-end loader or clamshell. The new Sauerman torque converter diesel-hoist automatically matches power to load demands and is designed for continuous duty. Fluid drive cushions out shock loads to reduce fuel and maintenance costs, extend cable life.

Increasing land values and depleting resources make it necessary to get all the material out of your deposit. You can do this with a Sauerman Slackline. The machine will dig from ground level to deep under water and keep your plant running additional years at the lowest possible operating cost. Several pits are now operating Slacklines on 1000-ft. spans with average hauls of 500 to 700 ft. and from 100-ft. depths.

Write or call, giving your tonnage requirements, depth and length of deposit—if available. We will promptly supply more information on Slackline Cableways, and show you how to *save with a Sauerman.*

SAUERMAN BROS., INC. 626 SO. 28th AVE. BELLWOOD, ILL.
LInden 4-4892 • Cable CABEX—Bellwood, Illinois

Crescent Scrapers • Slackline and Tautline Cableways • Durolite Blocks

Michigan *(Continued)*

dicate there is not a pattern of uniformity."

The Chicago & North Western Railway has proposed reduced rates on iron ore all-rail shipments in lots of 20 cars or more from the Gogebic Range in Upper Michigan to steel mills at Granite City, Ill.

The new rate schedule, filed with the Interstate Commerce Commission, would reduce the prevailing $4.55 a ton rate to $4.

C. J. Fitzpatrick, North Western president, said the reduction was designed to help ores from the Gogebic Range compete with increasing competition from South American ores shipped to Granite City through Gulf ports and up the Mississippi River.

The U.S. Government's rare-earth ion-exchange facility, recently declared surplus by the Atomic Energy Commission, came into the private ownership of Michigan Chemical Corp. in an open bidding sale. The unit, believed to be the largest of its kind in the world, was built by Michigan Chemical and is located within the company's St. Louis, Michigan, plant area.

MINNESOTA

For the first time in more than 25 years, the Portsmouth mine of the M. A. Hanna Co. at Crosby on the Cuyuna range is idle. Neither the pit nor the sintering plant has been operated in 1960, but the mine's washing plant is being employed to treat some of the ore from the Robert mine.

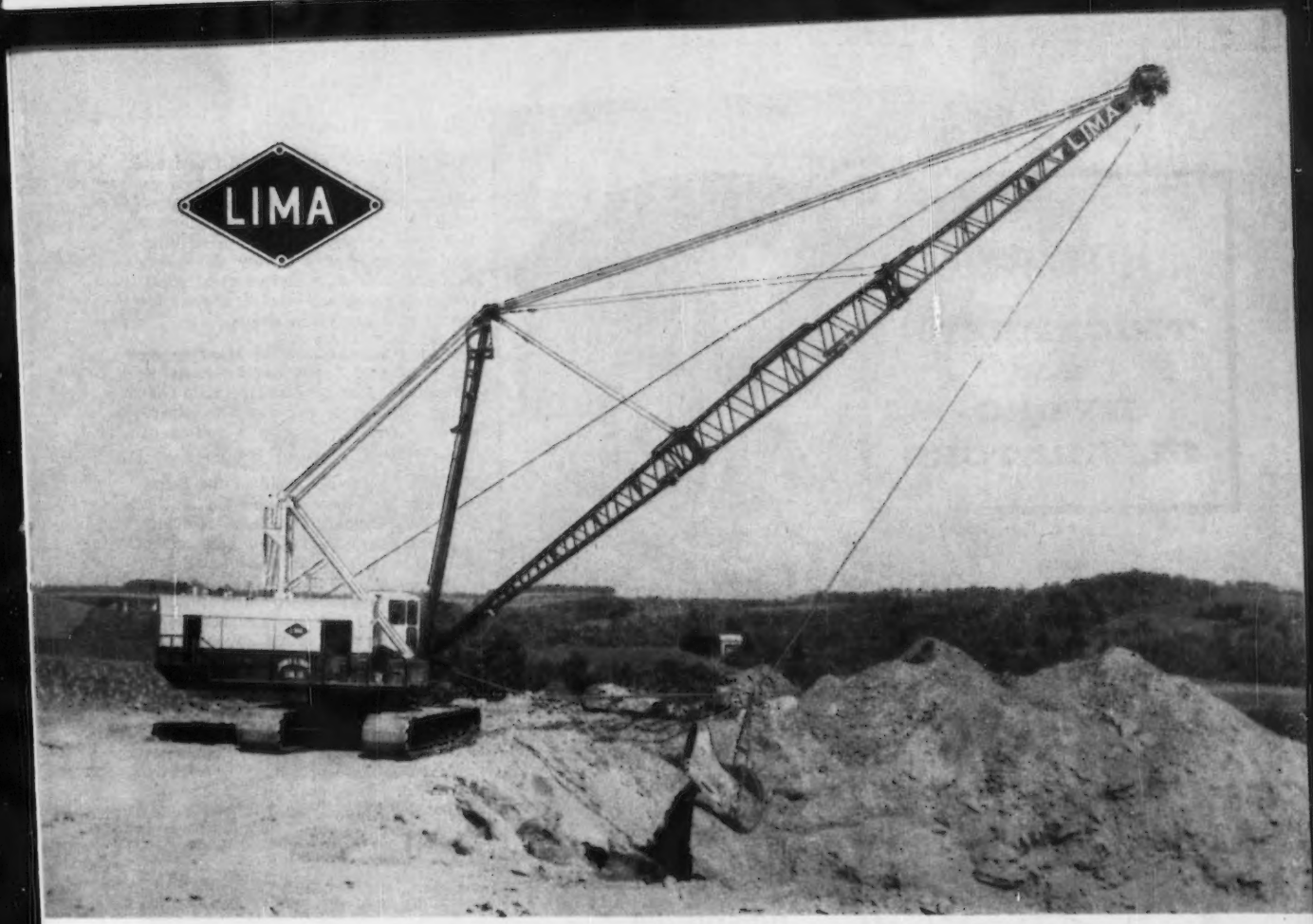
Hanna is operating five mines on the Cuyuna range: the Alstead, Feigh and Huntington at Ironton; the Musser at Trommald Village and the Robert at Cuyuna Village.

The new concentration plant at the Sherman mine near Chisholm, Oliver Iron Mining Div., is underway. Expected to be completed for the 1961 season, the plant will include a scrubber-wash section and heavy media equipment, cyclones and spirals. The plant will serve the Sherman group of mines.

The state of Minnesota, on October 2, granted a lease on the Mississippi No. 1 mine, near Keewatin, to the M. A. Hanna Co. The lease extends to the year 2008, and the State will receive royalties ranging from $1.19 to $1.62 per ton. The Mississippi No. 1, which has shipped a total of 3,483,005 tons, was operated by the M. A. Hanna Co. 1942-49; by the Haley-Young Mining Co. in 1952; the Missco Mining Co. in 1953, and the Pacific Isle Mining Co. 1955-57. The last shipment, 83,914 tons, was made in 1957. Estimated remaining tonnage is 186,992 tons.

MONTANA

A leveling survey between several localities in Montana is under way by an 11-



Giant Lima 2400 dragline equipped with 7-yd. bucket moves an estimated 3000 yd. in 9-hr. shift.

7-yd. LIMA dragline works 19 hours daily; maintenance less than $50 in 2 years!

"The Lima 2400 dragline is the best equipment buy we've ever made. It recovers about 500 tons of coal a day, working a 10- and a 9-hour shift. Yet maintenance costs in 2 years have amounted to less than $50."

Outwear, outlast, outstrip

"I checked before I bought the Lima—for my money, Limas are bigger, heavier and better built than comparable rigs of other makes. From wide, heavy duty brake and clutch bands to shock-reducing torque converter, the 2400 is designed to outwear, outlast and outstrip other machines on the market.

"I was impressed by the field service that the factory engineers provided in adjusting the new machine for me. They also saw to it that my operators were thoroughly familiar with the 2400. Both parts and service from factory and distributor are excellent. We also have a Lima Type 34 Paymaster. Both Limas have proven to be high performance, low maintenance machines." *From a report by the Harold A. Siegel Coal Company, Clarion, Pa.*

Make more money

Chances are a Lima could help you make more money by stepping up production and reducing operating costs because of its low maintenance requirements. Get the facts about Limas before you buy your next machine. There's a type and size exactly right for your needs. Variable capacity draglines; shovels to 8 yd.; crawler cranes to 140 tons, 80 tons on rubber. For complete information, see your nearby distributor or write to Construction Equipment Division, Baldwin-Lima-Hamilton Corporation, Lima, Ohio.

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LIMA Construction Equipment Division, Lima, Ohio

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Shovels • Cranes • Draglines • Pullshovels • Roadpackers • Crushing, Screening and Washing Equipment

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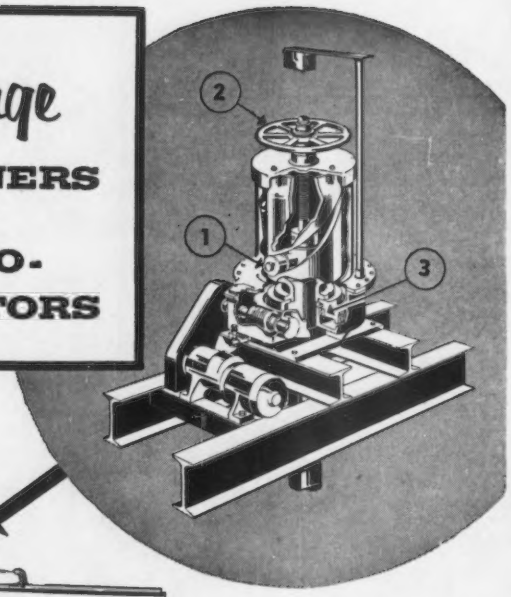
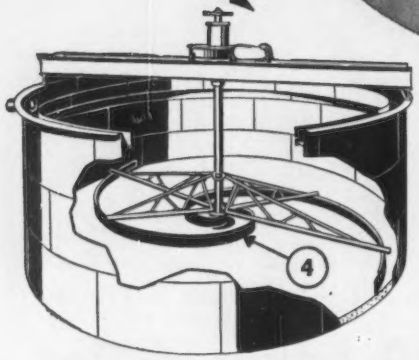
THICKENERS and HYDRO-SEPARATORS





. . . for all clarifying, thickening and de-sliming operations.

For flotation concentrates thickening ahead of filtering—or for tailings disposal or reclamation, Hardinge Thickeners provide:

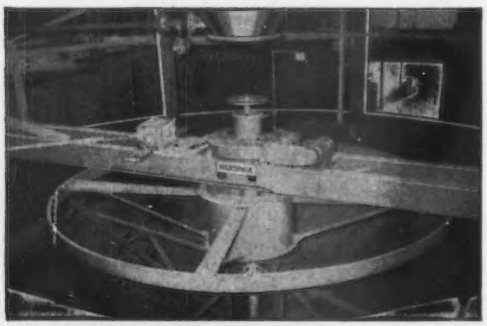
1. "Auto-Raise" to avoid lost production from overloads.

2. Manual or power raise to supplement "Auto-Raise."

3. Replaceable ring-type ball bearing support for rotating mechanism.

4. Spiral rakes for maximum underflow density.

Also available are froth rakes for froth-free overflow and superposed type tank construction for minimum floor space and building economy. Complete specifications on request. Bulletin 31-E-1.



A 35'-diameter Hardinge Superposed Thickener installation in a Canadian lead-zinc concentrator. The sludge outlet for the upper unit can be seen at the top of the picture. Note froth ring on lower unit.

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"Hardinge Equipment—Built Better to Last Longer."

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BIRMINGHAM

Montana (*Continued*)

man field party of the U.S. Coast and Geodetic Survey. Covering an area extending from Bozeman to West Yellowstone, West Yellowstone to Mammoth Hot Springs, Wyo., Livingston to Bozeman and Monida to Divide, the survey will determine exact elevations of selected points above sea level as a basis for topographic maps and charts.

Gov. J. Hugo Aronson of Montana recently accepted 22,000-acre Lubrecht experimental forest for Montana State University from Anaconda Co. The experimental forest will sustain a cutting of over one million board ft per year.

Clyde E. Weed, chairman of the board of directors of the Anaconda Co., told a Butte civic luncheon that the company will spend more than $20-million in the Butte area to improve underground and surface mining facilities. He said that plans call for increased mechanization and automation and that a higher degree of skill will be required to work the operation.

The Bureau of Land Management's Montana office will begin legal action to decide the ownership of certain surface rights on unpatented mining claims on public lands in Meagher County. Only unpatented claims located before July 23, 1955 will be affected by the action.

Anaconda Co. has announced changes in some sections of the Butte, Anaconda and Pacific Railway on Butte Hill to service future zinc ore production and to bring tailing fill to the Mountain Con Mine.

Development work is presently being done at the Black Rock-Elm Orlu low grade zinc block caving project, which will be serviced through the Badger shaft. Zinc ore production may begin about the first of the year.

Changing the railroad line involves 1,860 ft of new construction on a 3% grade east of the Mountain Con. The project will require 70,000 cu yd of borrow fill and 15,000 cu yd of excavation.

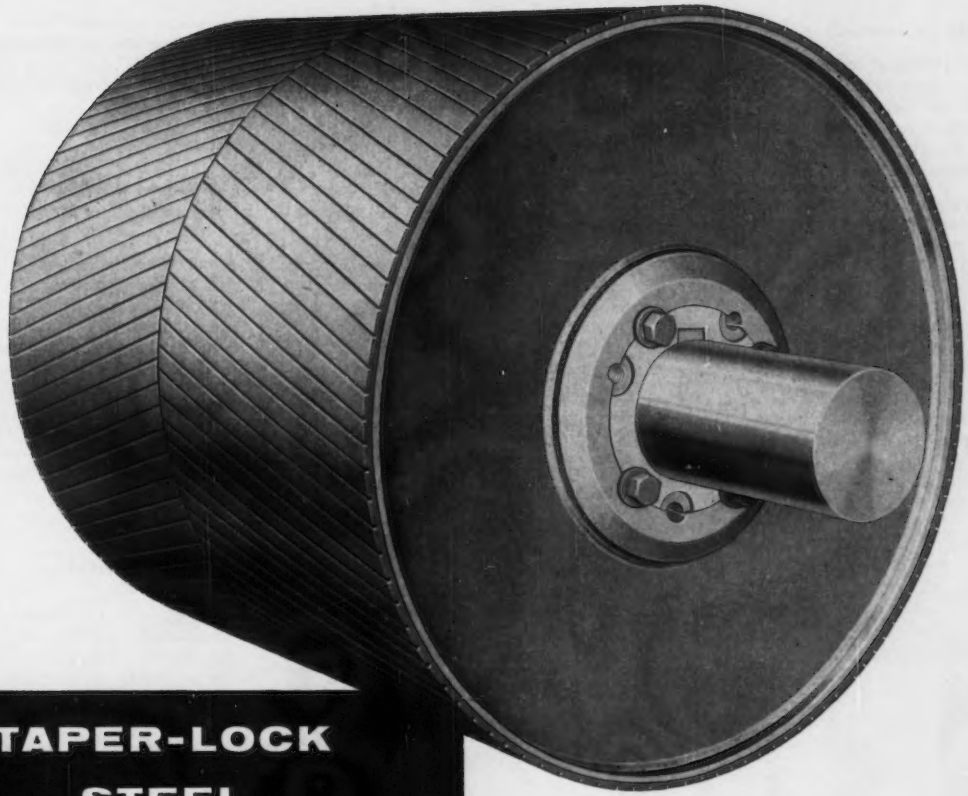
Claud D. Fike, a retired farmer, has discovered a four-ton chunk of Jade from nearby Green Mountains. Fike, who had to get a winch truck to bring the boulder back to Riverton, Wyo., where it rests on his front lawn, believes it is the largest single rock of jade ever recovered.

NEVADA

Bear Creek Mining Co., domestic exploration subsidiary of Kennecott Copper Corp., is core drilling in search for copper in the Lane City area of White Pine County.

Results of the program have not been disclosed by Bear Creek, although the firm, along with Nevada Mines Div. of Kennecott Copper Corp., has been busily acquiring properties in the Lane City area.

Louis Cyric and Tony Selig have taken a lease and option on the Van Ness mine,



TAPER-LOCK STEEL CONVEYOR PULLEYS

Maximum strength with minimum weight...

Unmatched holding power on the shaft...

New mounting simplicity.

The rims, discs and hubs of these modern conveyor pulleys are *steel*—and they are fused together into jointless drum construction for (1) maximum strength with minimum weight, (2) exclusion of dirt, water, steam, (3) terrific shock resistance.

With the patented Dodge Back-up Bar, welds of full rim thickness are achieved—and the ultimate in strength is assured by submerged arc process welds.

Taper-Lock Steel Conveyor Pulleys *hold*. Taper-Lock provides the equivalent of a shrunk-on fit—there is no "walking" on the shaft. Mounting and demounting are simple. Pulley and bushings mount as a unit. Alignment is easy. And the tapered bushing is wedged into place merely by turning the mounting screws. It is "unlocked" by using the mounting screws as jack screws.

Available in diameters from 6 inches to 8 feet—all face widths. Standard or special rubber lagging available. Ask your local Dodge Distributor—or write us for bulletin.

DODGE MANUFACTURING CORPORATION, 3100 Union, Mishawaka, Ind.

97 Taper-Lock Steel Conveyor Pulleys are used in this famous conveyor system engineered, manufactured and erected by Hewitt-Robins, Inc., at the Southern Pacific's causeway construction across the Great Salt Lake.

DODGE

of Mishawaka, Ind.

CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Equipment."

Nevada *(Continued)*

15 miles northeast of Manhattan in Nye County. Owner of the mercury producing property is Reliance Minerals Co., of Reno, which operated the Van Ness last winter. Development and production of ore is scheduled early in the fall.

Nevada's three active gypsum mines are maintaining a large level of production according to figures from the Bureau of Mines. U.S. Gypsum Co., with mines and plants in Pershing and Washoe counties, the Blue Diamond Co. and Fireboard Paper Products Co., both in Clark County, are producing a total estimated at 65,000 tpm.

U. S. Mining & Minerals reopened its Ohio mine at Gold Point in Esmeralda County early in September following a brief shut-down. The property is now employing 21 men on two shifts. Ore values are running better than $40 per ton in silver and gold; and shipments are averaging 50 tpd. Ore is being mined on the 800-ft level from a 14-ft face and is being shipped to the U.S. M. & M. mill at Silver Peak.

Management of Apex Minerals Corp., one of Nevada's leading uranium producers, was reorganized in September. Walter McFadden, of Los Angeles, replaced Rudolph Rundberg, of Austin, as president, and Richard Vaughn, of Los Angeles replaced Carson Frazzini, of Austin as vice president. Louis Sonnen, of Houston, Tex., was named general manager replacing Fred Vollmer, but Vollmer was retained as consultant for the organization. Walter Naismith was retained as secretary. Apex Minerals Corp. operates the Apex mine east of Austin and has been shipping large quantities of ore to the Vitro mill in Utah during the last several months.

Boyle Bros., who had been test drilling for Kennecott Copper Co. north of Yerington, have completed three holes in that area and moved their rigs south of Yerington where they are now drilling test holes for Columbia Iron Mining Co., a subsidiary of U. S. Steel. Columbia is also continuing an extensive test-drilling program in Pershing County's Mineral Basin where U.S. Steel holds extensive properties purchased from Mineral Materials Co.

NEW MEXICO

U.S. Borax & Chemical Corp. will build additions to its plant in Carlsbad, New Mexico, to produce chemical grade muriate of potash, 99.9% pure. Marketing of the material will begin in early 1961.

NORTH CAROLINA

A. L. Nash Jr. is conducting experimental drilling operations for phosphate in the Bayview area of Beaufort County. Nash is trying to force the phosphate to the surface with water channeled underground by pipes.

Two mining firms, Bear Creek Mining Co. and General Crude Oil Co., tried mining the phosphate commercially but gave up in 1958. The ore, up to 150-ft below the surface, exists in a 30- to 40-ft deposit covering about 450 sq miles.

The experimental operations consist of drilling two holes. Water is forced through one, thus forcing the phosphate up the other.

PENNSYLVANIA

Pennsylvania State University will expand research on bastnasite. Under the sponsorship of the Molybdenum Corp., the school will investigate new uses for the rare earths and preparation of new products from the material. Ore for the project is mined at the Molybdenum's rare earth mine at Mountain Pass, Calif., and is processed at plants in Washington and York.

TENNESSEE

The former Cramet Inc. titanium sponge plant, located in Chattanooga, was auctioned early in October by the GSA. The plant was sold, not as a unit, but in separate groups of equipment and tools.

This facility, financed mainly by the

Lighter! Stronger! Safer! **Exclusive new expanded polystyrene case for B&A® "C.P." Acids!**

AN EXCLUSIVE DEVELOPMENT of General Chemical, this new "one-way" case holds four 5-pint "C.P." acid bottles in contoured pockets formed of shock-resistant polystyrene.

SMALLER! LIGHTER! Tare weight of this substantially smaller case is less than 11 lbs. with empty bottles.

EASIER TO HANDLE! Finger grips make case easy to handle. Cases stack securely with interlocking top and bottom.

SAFER! The new polystyrene case is chemical and weather resistant. Form-fitted pockets protect bottles.

STRONGER! The new case, far stronger than other "one-way" cases now in use, has met the most stringent ICC drop test requirements.

ORDER NOW! These new units are now ready for shipment from General Chemical's B&A distributing points coast to coast. More than a year of intensive research and testing prove this new case superior to any other type of "shipper." For information phone or write your nearest B&A office.

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°*Complete stocks carried here*

This fast and maneuverable **Eimco 630 Excavator** purchased by Constructora Estrella, is giving extraordinary results by its rapid loading of light trucks as it tunnels beneath Mexico City.

"EIMCO HAS THE BEST MACHINE IN THE WORLD,"

says Engineer Cravioto, Manager of

CONSTRUCTORA ESTRELLA, S. A.

Constructora Estrella is one of several contractors digging the 17 kilometer (10.56 miles) long Drainage Tunnel beneath the west part of Mexico City. The tunnel is being driven from south to north, and Constructora Estrella's section includes the roughest digging conditions. The completed project will consist of 13 kilometers (8.1 miles) of concrete lined tunnel with an opening of 4 meters (13.1 feet) in diameter.

Engineer Cravioto says, "Eimco has the best machine in the world. I never thought that so small a machine would be able to handle such a tremendous amount of material per minute. If you have another prospect for an Eimco 630, just bring him to me and I will sell the machine for you, for the results this machine is giving are extraordinary in loading light trucks."

Independent control of each crawler track assures greater maneuverability; rapid loading and discharge means more loading capacity; quality construction and craftsmanship result in minimum maintenance costs.

Learn how to make the dollars you invest in equipment work harder and earn more. Contact the Eimco agent or dealer nearest you or write for full details and specifications to:
The Eimco Corporation, P.O. Box 300, Salt Lake City 10, Utah, U.S.A.

"ADVANCED ENGINEERING AND QUALITY CRAFTSMANSHIP SINCE 1884"

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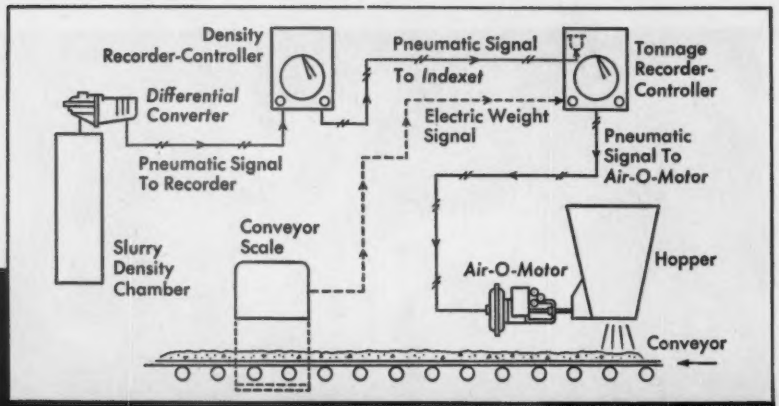
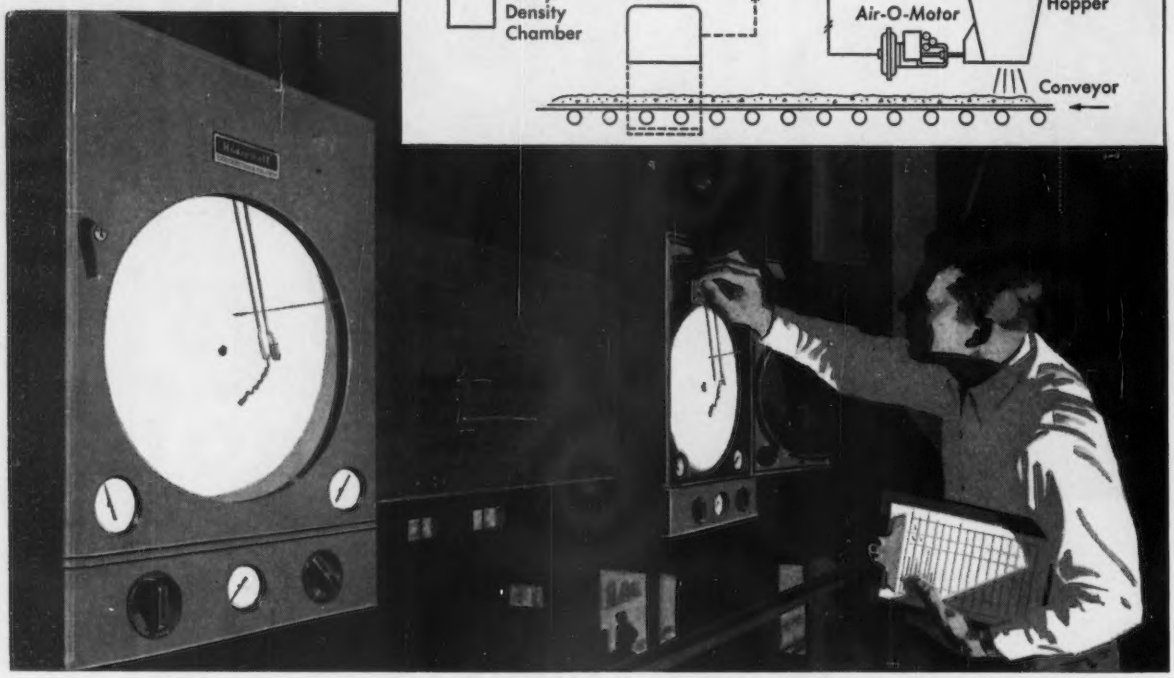
BRANCHES AND DEALERS IN PRINCIPAL CITIES THROUGHOUT THE WORLD

Metallurgist at American Smelting and Refining Co. adjusts recorder-controllers that automatically maintain constant density of copper slurry by varying tonnage fed to ball mill.





Copper slurry density held within ± 0.2% with Honeywell controls

American Smelting and Refining Co., Silver Bell, Arizona, gets excellent classification of copper slurry . . . holds tonnage and copper recovery high by keeping slurry density constant with a Honeywell control system.

Copper-containing ore is mixed with water in a ball mill, and the overflow is pumped to a cyclone classifier. Overflow from the classifier is fed to the flotation section, where the copper is floated off. Between the classifier and flotation section, slurry density is measured by a displacement unit. A *Differential Converter* transmits the density signal pneumatically to a recorder-controller. This instrument, in turn, transmits a pneumatic signal to the *Indexet* unit which automatically positions the set point index of a tonnage recorder-controller. The tonnage controller is actuated by a conveyor scale on the ore conveyor, and operates a pneumatic *Air-O-Motor* actuator on the gate of the hopper feeding the conveyor. While the tonnage controller responds primarily to weight on the conveyor, it is influenced, through the density controller and *Indexet* unit, to add more ore from the hopper when slurry density is not high enough.

Your nearby Honeywell field engineer can help you profitably apply these controls and Honeywell instrumentation for many other metal production processes. Call him today . . . he's as near as your phone.

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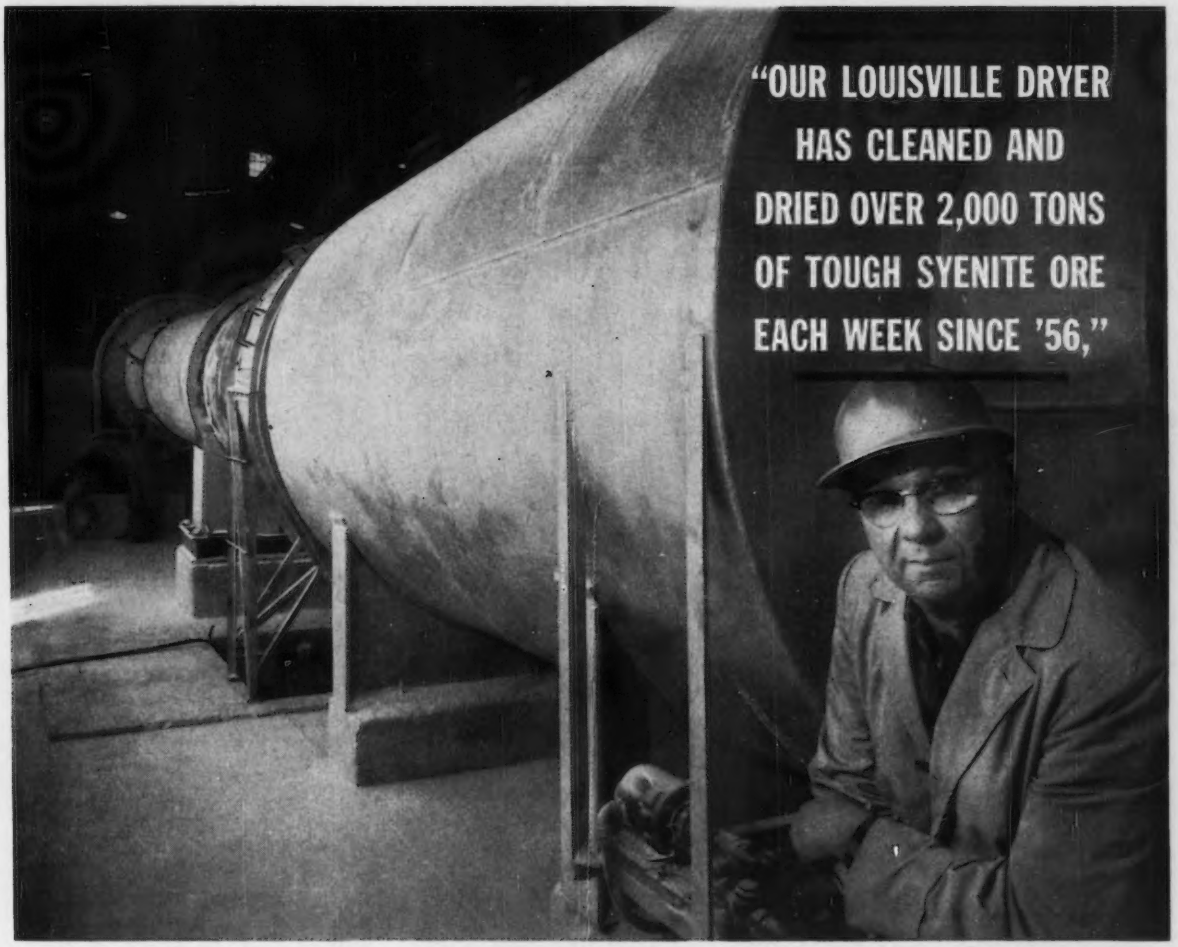

. . . says superintendent
Leo F. McDonnell
of International Minerals &
Chemical Corporation, Ltd.

The International Minerals & Chemical Corporation, Ltd., likes this Louisville Dryer for three reasons. It requires minimum operating manpower, minimum maintenance and shows remarkably little wear.

Completely automatic, it is operated by only one man. The drum itself, which is made of ¾ inch plate steel still shows no sign of inside wear, even after processing thousands of tons of tough, abrasive nepheline syenite ore. Maintenance of the dryer is a simple matter easily accomplished by plant personnel.

Says superintendent Leo F. McDonnell, "We have enough ore to keep us going for a hundred years or more. We have every reason to believe that the Louisville Dryer will be giving good reliable service for a good many of those years."

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Tennessee (*Continued*)

government, operated for only one year at an estimated cost to the government of $65-million.

Tennessee Copper Co.'s sulfur-dioxide plant at Copper Hill, was completely destroyed by fire in September. Tennessee Copper mines approximately one-million tons of pyrrhotite and pyrite ore annually.

The East Meyer barite mine went back into production in September. Approximately 60 tpd of chemical grade barite is shipped to Columbia Southern's plant in West Virginia. The barite is mined from a 5-ft-wide vein, then passed over Denver jigs in the mill to obtain a product assaying 97% $BaSO_4$.

UTAH

Two companies have formed a joint-venture operation to produce vanadium pentoxide in a newly acquired plant near Salt Lake City. The firms, Minerals Engineering Co. of Grand Junction, Colo., and Susquehanna-Western Inc., Denver, will employ an entirely new process to chemically extract vanadium from vanadium-bearing slag. This slag was a wasted by-product of western phosphorus operations.

The Anaconda Co has taken option from McFarland and Hullinger, mine contractors, on the Scranton lead-zinc mines about eight miles north of Eureka.

The properties cover 21 claims. They will be mapped geologically and sampled. Pending the results of this work, "some drilling may be attempted to extend the ore shoots exploited in old mine," the company reported.

Vitro Uranium Co. reduced the production pace at its Salt Lake uranium mill on Oct. 16 by placing the entire operation on a five-day week instead of seven. Ore run was reduced from 660 tpd to 500 tpd.

The curtailment, said a Vitro spokesman, resulted from a desire to establish a more economical rate of production until March 31, 1962, when the existing contract with AEC runs out.

Vitro has been making a greater rate of delivery under its total poundage contract to AEC in recent years. To conserve pounds so that the plant may continue operations through to the 1962 date, the reduction in monthly ore runs from 15,000 to 13,000 tons was effected.

Meanwhile, negotiations with AEC on concentrates sales contract for 1962-1966 period continue.

Cardiff Industries Inc., Salt Lake City, says it believes it has cut the old high-grade Cardiff silver ore body during explorations in old Alta-Brighton mining districts.

J. J. Beason, Salt Lake, consulting geologist, reported, "The ore exposed is believed to be a downward extension of the Cardiff ore body . . . and may extend up-dip 280 ft to the 1,400 ft level."

Uranium Reduction Co., Moab, says it is "unfortunate" that some U.S. uranium mills are selling concentrates to American industry and foreign governments below the $8 a lb AEC price.

The comment was contained in annual report of the firm presented during a recent meeting of stockholders at Salt Lake City.

Mitchell Melich, URC president at Moab, said, "Ours is a new and growing industry in which large sums have been invested. Its profits for the risks involved are not excessive, but only reasonable. The demand for our product, improvements in technology and mining methods and our competitive economy, will, from time to time, determine the price we should receive for pure uranium.

"But it seems premature and unwise to now offer it at an unrealistic price which can only be harmful to the long-term future of the entire uranium industry."

VIRGINIA

Mineral production in Virginia in 1959 was valued at $222-million, about 9% over 1958, the State's mineral resources division reports.

This value was second only to the 1957 record of $227-million. Coal, stone, cement, and sand and gravel were the major mineral products.

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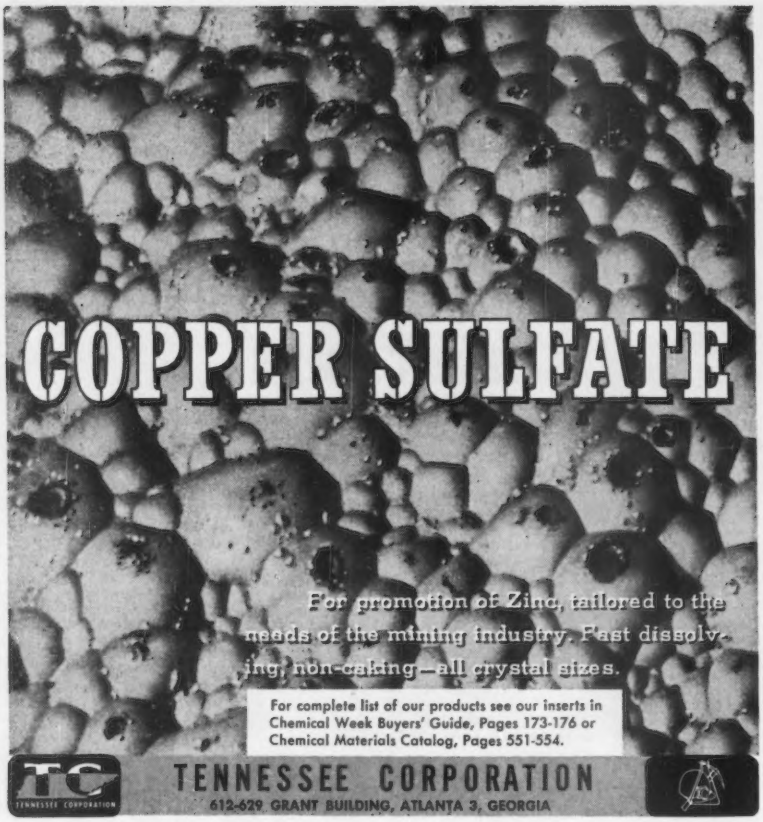
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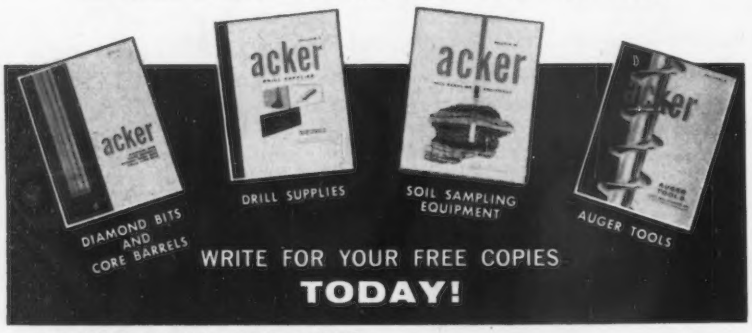

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☐ Bulletin 12—Soil Sampling Equipment
☐ Bulletin 13—Auger Tools

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WASHINGTON

Test runs of lead-zinc ore have begun at the new concentrator operated by Clayloon Uranium Co. at a property near Leadpoint. Some revisions will be made in the mill before concentrates are shipped.

A group of Chewelah men have resumed barite mining operations on claims on Eagle Mountain, six miles east of Chewelah. Bulldozing exploration has uncovered an ore deposit and underground mining is planned.

Harold Hightower, Inchelium, and Loyal F. Bailes, Seattle, have discovered a beryllium-bearing ore deposit on Calispell Mountain, 20 miles northeast of Chewelah. The ore was found in a bulldozer trenching operation.

Reynolds Metals Co. will spend $600,000 to expand its Longview aluminum reduction plant, according to plant manager, D. W. Johnson.

The expansion, scheduled for completion in about six months, will make possible production of extrusion ingot, other improved ingot products and bar stock for making aluminum conductor wire.

The 13,000-sq ft building will house three new holding furnaces for processing of the metal prior to casting ingot of various shapes and sizes. New equipment will include a horizontal casting machine, sawing equipment and homogenizing furnaces.

Daybreak Uranium Inc., Opportunity, in September made its first 1960 shipment of uranium ore from the Dahl lease on Mount Spokane, according to Kac Sowers secretary-treasurer of the firm.

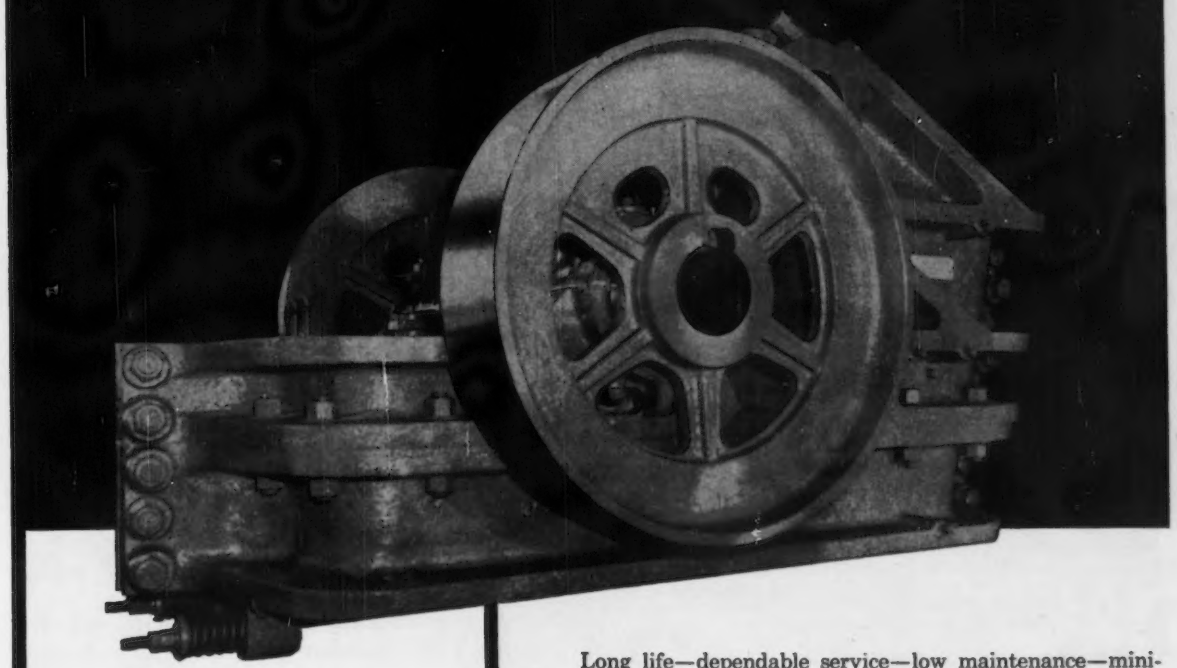
About 250 tons had been shipped to the Dawn Mining Co. processing mill at Ford by the middle of September. The firm has stockpiled another 800 tons at the property where a new ore zone was located by exploratory drilling.

High grade zinc ore has been located at the old Schumaker property on Joe creek northeast of Colville by Triton Mining Co. Officials of the firm at Colville said development work during the past summer included deepening of a 30-ft winze. The firm also constructed an access road to the south end of the property and started diamond drilling from the end of an old tunnel. A vein found 115 ft beyond the face of the tunnel indicated 12 ft of high grade zinc in drill cores. A compressor house and other equipment is being installed in preparation for extending the tunnel this winter. The firm plans to move its 65-ton mill at the Pioneer mine to the Schumaker property.

The second stage of a zinc development program has been started by Goldfield Consolidated Mines Co. near Leadpoint at the old Anderson open pit mine which has been shut down since 1952 because of poor metal prices.

Three new ore deposits, ranging up to 100 ft thick and 100 ft wide and located by diamond drilling over the last three years, will be reached by a 1,500-ft tunnel that will go to the bottom of the 100-ft deep pit area.

KENNEDY JAW CRUSHERS



The KENNEDY Overhead Eccentric Jaw Crusher features a massive, one-piece, arc welded steel plate frame, and is available in standard sizes from 10″ x 36″ to 36″ x 42″.

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- Jaw plates are interchangeable and reversible. Shaft is integral with swing jaw.
- Available in standard sizes from 7″ x 10″ to 66″ x 84″.

Send for complete information on KENNEDY Crushers.

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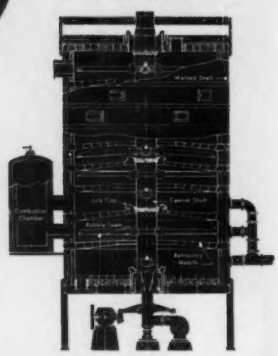

Nichols Herreshoff* and Bethlehem Wedge Multiple Hearth Furnaces are available with design modifications to prevent air infiltration and to permit maintenance of a reducing atmosphere in the hearth spaces. Either solid or gaseous reductant can be used.

Nichols furnaces of this type are being used for the reduction of nickle-iron ore at Nicaro, Cuba, (photo shown below) and for magnetic roasting.

For further information, please write for Bulletin No. 233, mentioning "reduction roasting," to:

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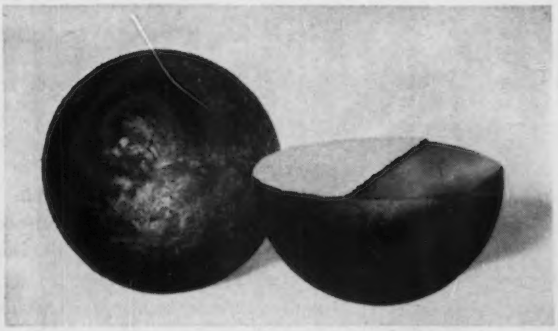

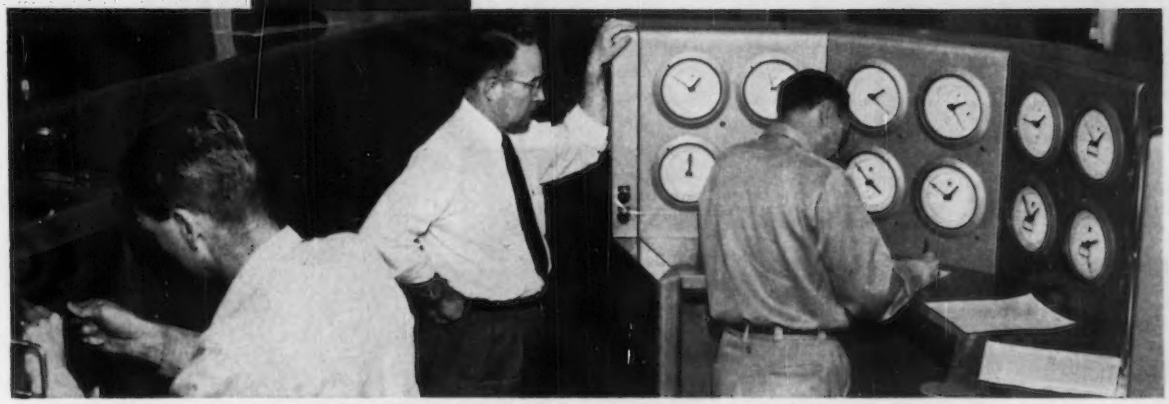

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WYOMING

Plans for a $5-million gypsum plant near Lovell received a boost when directors of Crystal Creek Gypsum Co. agreed to transfer 67 gypsum claims along the Big Horn River to a corporation which will be formed shortly.

The claims are located near Himes, about 13 miles southeast of Lovell. The proposed plant will be built about a half mile from the claims.

It is the second large gypsum plant going into northwestern Wyoming. Big Horn Basin Gypsum Co. broke ground recently for a $3-million gypsum board plant near Cody.

IN CANADA

ONTARIO

Following the merger of Preston East Dome and Stanleigh Uranium Mining Corp. Rio Tinto Mining Co. has announced a new operational policy for the uranium mines under its control in the Elliot Lake area. Stanleigh is to continue operations until Nov. 30, 1960. The balance of the contracts are to be filled by Nordic, Panel, Milliken and Quirke. Quirke is to be closed at the end of this year, while Panel is to continue to mid-1961 and the Nordic and Milliken will operate on long term to complete contracts.

Dominion Explorers has started exploration of the Lucky Godfrey silver property near Elk Lake. In previous work by former owners, a 100-ft shaft was put down and over 180 ft of lateral work was completed.

Chesterville Mines has come up with a new gold discovery 15 miles east of Longlac. Preliminary surface work picked up good gold values on a surface vein structure at points 30 ft apart. Only a limited amount of prospecting has been completed and it is understood that a drill will be moved in as soon as possible after staking has been completed.

Lindsay Explorations is going ahead with production plans for its gold property at Sapawe, some 10 miles east of Atikokan. Sinking of the 3-compartment shaft, which is to be carried down to an initial depth of 400 ft, will be resumed shortly. Two working levels are to be opened at 175-ft and 350-ft depths. Construction of a 100-ton cyanide mill is expected to be completed by next summer.

Decreased demand from the U.S. steel industry has resulted in a sharp drop in iron ore shipments from the Steep Rock Iron Mines' property near Atikokan. To mid-October, shipments were just above the 1.5-million-ton mark compared with over 2.1-million tons at the end of September last year. The anticipated fall pick-up in sales did not materialize and orders continue at a slow pace.

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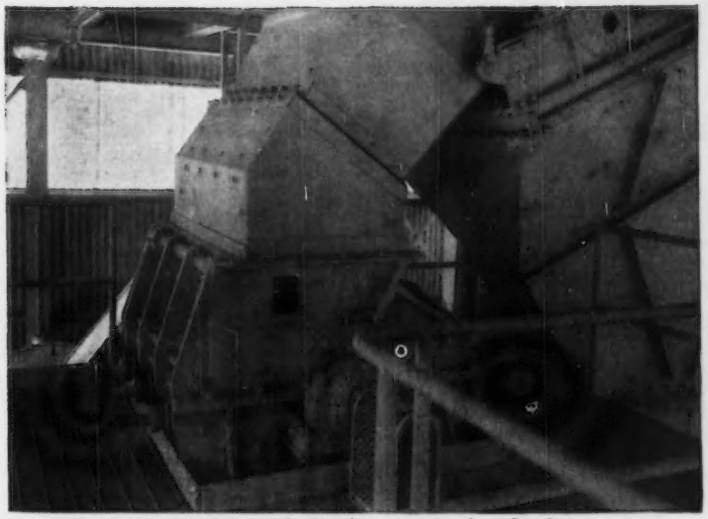
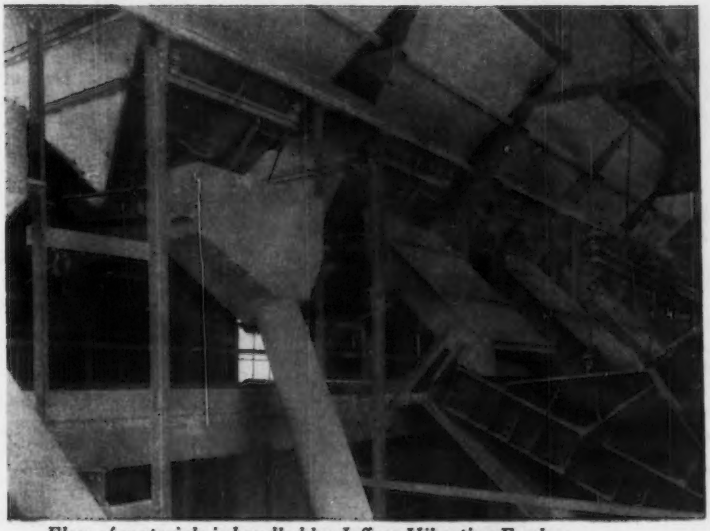
Jeffrey Crawler-Loader working at salt mine installation



Jeffrey 36" x 48" Flextooth Crusher on potash reduction



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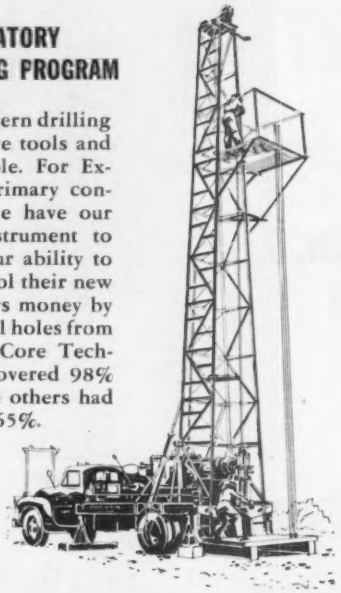

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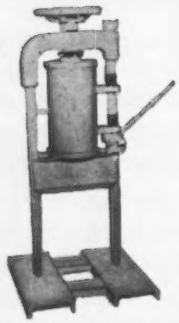

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Ontario (*Continued*)

American Smelting & Refining Co. has offered to handle all production from Cobalt and Gowganda at its East Helena smelter in Montana. Operators will receive approximately the same price for their silver as they had been receiving from Deloro Smelting & Refining. Deloro, the area's refiner for 50 yrs, has ceased operation. In the meantime, a committee of mine operators are considering proposals which would provide for refining their own concentrates in the Cobalt area.

Kam-Kotia Porcupine Mines is making good progress with construction of a concentrator at its copper property 24 miles west of Timmins. The 800-tpd plant is scheduled for completion in February.

QUEBEC

Quebec Lithium has started production of lithium carbonate from the refinery at its mine in the Val d'Or area. With the start of refinery output, mining and milling operations are being resumed at the mine. The existing stockpile of chemical grade lithium is sufficient to produce two million lb of lithium carbonate or enough for four months' refinery operations at capacity. The mill, which has a capacity of 1,000 tpd, is to be operated at a rate sufficient to meet customer requirements and the company's own needs.

Possibilities of large lithium deposits (with some beryl) have been indicated in work completed at Sirmac Mines' property in the Assinica Lake area, 80 miles northwest of Chibougamau. Surface work has been carried out on four pegmatite dikes with the main showing traced for a length of 1,800 ft with widths up to 350 to 400 ft. A number of other dikes are known to occur on the property but have not yet been examined in detail. Examination has also indicated a significant number of beryl crystals, some of which have shown a diameter of from 6 to 8 in.

Marban Gold Mines is opening a new zone on the 800-ft, or bottom, level at its Malartic area gold property. It has been opened by some 300 ft of drifting and current indications are that it will prove to be a large low grade deposit. Average of face samples has given a value of $3.50 per ton with widths running up to 138 ft.

BRITISH COLUMBIA

Skookum Uranium, Inc., is recovering gold at a placer operation 11 miles southwest of Salmo, B. C. The gold lies at a depth of 27 ft at the lower end of a 300 ft trench bulldozed in Fifteen-Mile Creek. It occurs in a layer of gravel on bedrock between layers of silt which have been consolidated into sandstone.

Fort Reliance Minerals Ltd. of Toronto announced in its annual report it has

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The NAYLOR Wedgelock coupling makes a positive connection, securely anchored in standard weight grooved ends.

The combination of NAYLOR Spiralweld pipe and Wedgelock couplings provides a practical guide to save time and work in pipe line construction for mining service.

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Write for Bulletin No. 59.

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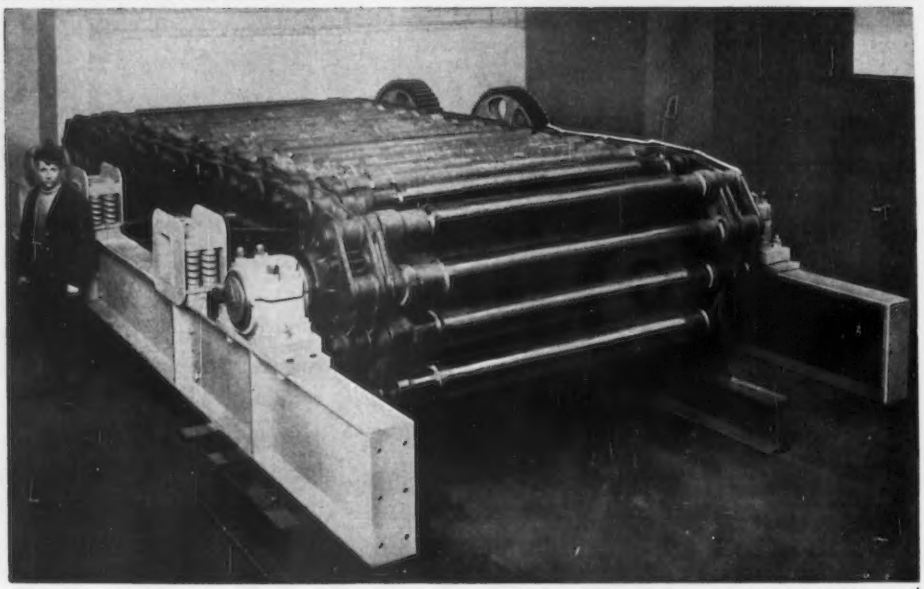

Photograph shows a No. 10 Ross Patent Drop-Bar Feeder assembled before despatch to Llanddulas Quarries for feeding a 60" x 42" Jaw Crusher. The photograph illustrates the very heavy construction of the apron, in this case 7" dia. steel bars at 10" centres and the heavy shock-absorbing coil springs which support the apron.

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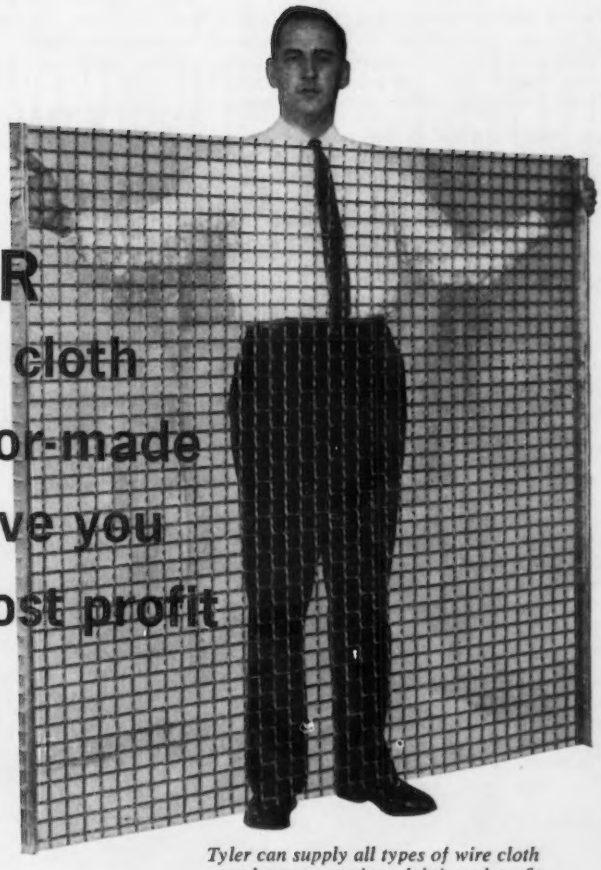
TYLER wire cloth is tailor-made to give you the most profit



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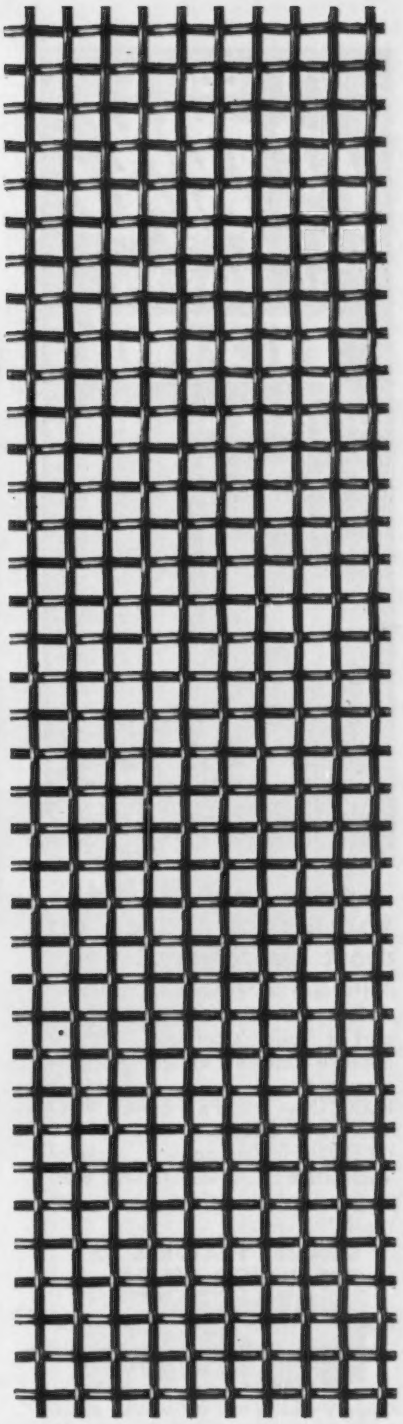

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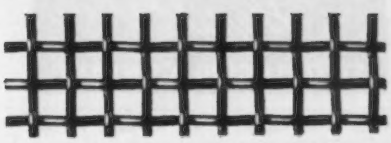

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B. C. (*Continued*)

acquired two new mineral deposits in B.C. One is a lead, zinc, silver property at Haskins Mountain in northern B.C., and the other is a gold and iron prospect called the Windpass in southern B.C.

Allied Mining Services Ltd. is installing a five-ton gold mill on the Tofino Gold Mines property at Tofino. Allied holds the property under lease. Underground work is concurrent with mill installation.

In order to boost its ore reserves, Cowichan Copper Co. Ltd. is planning to gain control of four small Vancouver Island properties. They are Nadira Mines, Avallin Mines, Cellardor Mines and Caycuse Copper, all headed by O. G. MacDonald, Cowichan president. Ore reserves at the Cowichan Lake mine have dropped and some ore is being shipped in from Nadira to keep up the 325-tpd mill rate. Japanese interests are taking all Cowichan copper concentrates and about 25,000 tons will have been shipped by the end of the year when the contract expires.

Coast Copper Co. is negotiating with two Japanese mining firms, Mitsubishi Mining Co. and Dowa Mining Co., who wish to buy concentrates.

At Coast's recent annual meeting, president W. G. Jewitt said they hope to have the mine in production by 1962. Coast, controlled by Consolidated Mining & Smelting Co., has 2-million tons of ore averaging 2.5% Cu.

Craigmont Mines Ltd. reports semi-proved ore reserves at its Highland Valley property have been boosted to 17.6-million tons, averaging 2.08% Cu and 20.2% Fe. This is an increase of 570,000 tons from earlier reports and a boost of 0.04% in copper grade.

Probable ore reserves of 4,637,000 tons, grading 2.13% Cu and 18.4% Fe, have also been indicated by diamond drilling. Of the total of 22.2-million tons, it is estimated about 8.6-million tons can be recovered by open pit mining.

The report said the 3,000-level adit was advanced 779 ft and is now 5,739 ft from the portal. Diamond drilling work totalled 18,641 ft from underground stations and 401 ft from the surface.

ALBERTA

The Alberta Government has approved applications for permission to conduct non-commercial and experimental projects in the province's oil sands submitted by Shell Oil Co. of Canada, Ltd., Pan American Petroleum Corp., and a four-company team headed by Cities Service Athabasca Inc.

IN LATIN AMERICA

BRAZIL

A group of independent iron-ore miners in Brazil's Paraopeba Valley have offered to help finance re-equipment of the wide-gage Central do Brasil Railroad to facilitate ore shipments for export.

The group, headed by Ricardo Jaffet who controls Mineracao Geral do Brasil, has been halted in efforts to boost exports by lack of sufficient railroad equipment and inadequate port facilities in Rio.

Meeting with officials of Brazil's Federal Railroad Network, mining representatives also proposed formation of a joint committee of mine, port and railroad authorities to advise on and supervise work of improving ore-handling facilities at the port of Rio de Janeiro.

The group's offer of financial aid to the Central do Brasil parallels a similar offer by the Hanna Mining Co., still under study by government agencies. Hanna proposes as a starter to ship from 2- to 3-million tpy of ore from properties formerly belonging to the St. John d'El Rey Mining Co. near Belo Horizonte.

CHILE

National Mining Enterprise will spend $2.1-million on new mills and extensions to its copper operations, according to General Manager Enrique Valenzuela.

A sulphuric acid plant and a leaching plant will be built at El Salado near the port of Chanaral if the government allows the importation of sulphur

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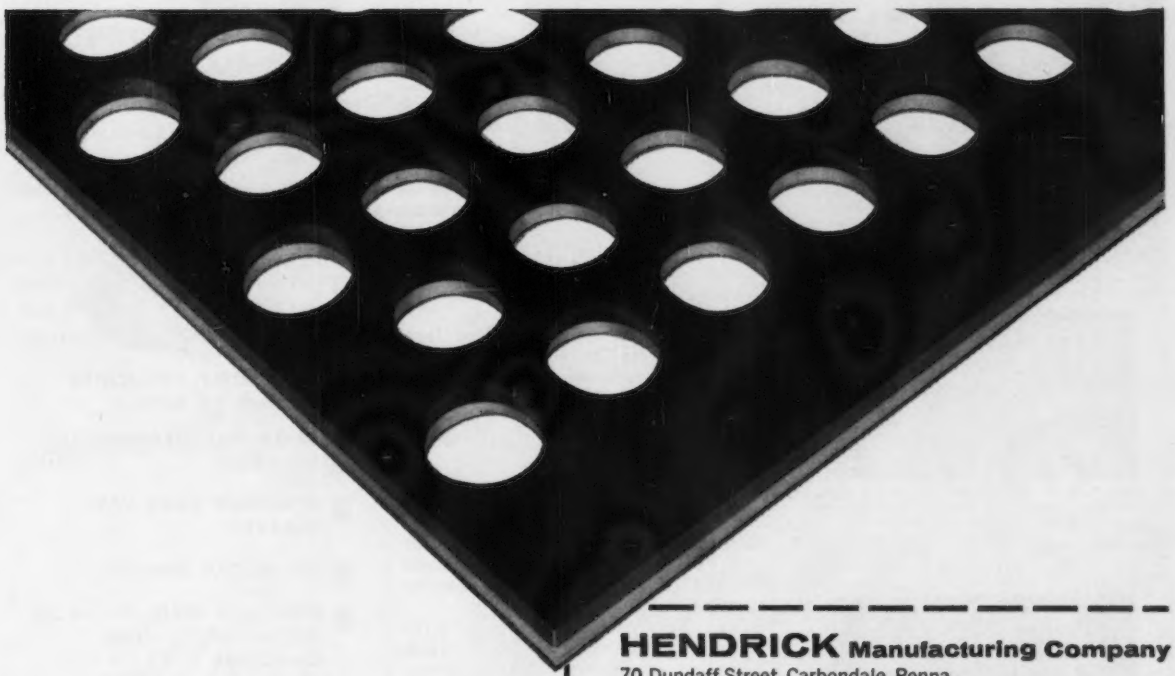

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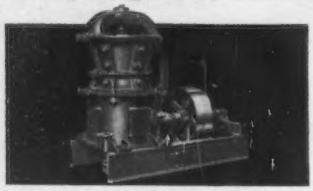
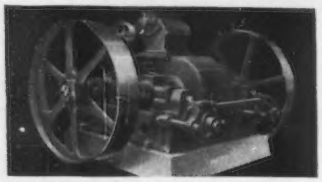
Jaw Crushers — Produce coarse (5 in. largest model) to fine (⅛ in. smallest model). Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smallest sizes operate on double cam principle — crush double per energy unit. *Request Bulletin No. 062.*



Rotary Fine Crusher — Reduce soft to medium hard 3 to 8 in. material down to ¼ to 1¼ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Non-clogging operation. Single handwheel regulates size. *Request Bulletin No. 063.*



Crushing Rolls — Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types — Balanced Rolls; Plain Balanced Rolls; Laboratory Rolls — all may be adjusted in operation. *Request Bulletin No. 065.*

Hammer Mills — Reduce to 20 mesh. Swing-Sledge Mills crush or shred medium hard material up to 70 tph. Hinged-Hammer Pulverizers crush or shred softer material at rates up to 30 tph. Four Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30½ in. Four Hinged-Hammer Pulverizers with feed openings from 12 x 12 in. to 12½ x 24 in. *Request Bulletin No. 084.*

**Reports Manager W. Carleton Merrill concerning Sturtevant Swing-Sledge Mill at James F. Morse Co., Boston.*

STURTEVANT
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Chile *(Continued)*

from Mexico or the U.S. To take advantage of power and water at its Paipote holdings, National will build a 500-tpd smelter on the site.

Other plans include a new flotation mill at San Lorenzo in Coquimbo Province and power line extension from Paipote to the flotation mill at Elisa de Bardos.

Chile's Central Bank has conditionally authorized Compania Minera Santa Fe to export 15.5-million long tons of iron ore within the next five years. Canadian Foreign Ore Development Ltd. will get all of the ore. However, Santa Fe must bring $15-million into the country.

Compania Minera Cerro Negro, which has mines and a 300-tpd flotation mill near the town of Cabildo in Central Chile, has been successful in developing its new copper deposit of El Diablo after the Pirquitas mine was worked out. El Diablo orebody is a breccia mineralized with bornite and chalcopyrite running about 3.0% copper.

PERU

The Peruvian Government has awarded a contract for the construction of the 40-km Huadquina-Quillabamba extension of the Cuzco-Santa Ana Railway to the Japanese firm, Mitsubishi Shoji Kaisha Ltd.

The overall investment will be $5.6-million, 10% due on the signing of the agreement, 10% when work is started, and the balance over a ten-year period. Minerals and other raw materials will be accepted in repayment of up to 60% of the investment, if a barter transaction of this nature is found feasible.

Congressional approval of the Japanese proposal is pending, however. M.S.K. representatives say that immediate acceptance of the deal can mean completion of the project in two years.

VENEZUELA

Orinoco Mining Co., U.S. Steel subsidiary, has renounced its undeveloped "Piacoa" iron ore concessions near the Orinoco River.

The five concessions, totaling 6,175 acres, contained an estimated 100-million tons of low-grade ore, according to figures of the Ministry of Mines & Hydrocarbons.

Rights were acquired by Orinoco Mining's predecessor in 1946. They were due to expire in December this year.

IN AUSTRALIA

The Australian federal government has decided to vacate the mica field and to leave it entirely to private operators.

The actual implementation of this decision is unlikely before December, 1960,

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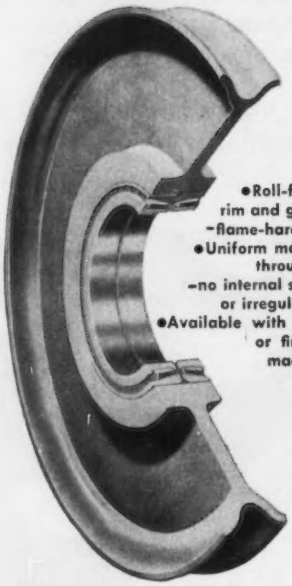

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WRITE FOR BULLETIN FS-6A

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Thor POWER TOOLS

Australia (*Continued*)

but it will definitely not be reversed. The Government Mica Pool will be then disbanded as it failed to maintain activities in the mica mining industry and was incurring constant fiscal losses. Australian production has fallen to a mere 25,000 lbs. Australian imports will continue to come predominantly from India.

IN THE PHILIPPINES

Atlas Consolidated Mining Co., largest copper producer in the Far East, mined and milled 1,665,431 tons of 0.63% copper ore at the Toledo mine in the first half of 1960. From this tonnage, 17,869,343 lb of copper were recovered. By comparision, during the same period last year, the mill treated 1,976,766 tons of ore and produced over 21-million lb of copper. During the period, the company realized a net profit after taxes of $740,000.

Itoh Trading Co. of Japan is undertaking a joint mine development project with Surigao Consolidated to develop the Pionia iron mine 20 miles north of Pagadian in Mindinao. The property has an estimated 6-million tons of ore and the 200,000-ton annual shipments to Japan will start in about two years.

IN EUROPE

USSR

A group of Soviet Scientists has decided that the earth's core is composed of iron, not ferrous alloys as most scientists believe.

TASS reports that a group working under Professor Lev Altshuller at the Academy of Science's Institute of Earth Physics arrived at their conclusion on the basis of experiments in which iron was compressed by means of shock waves up to 5-million atmospheres (Pressure at the earth's center is believed to be about 3.5-million atmospheres).

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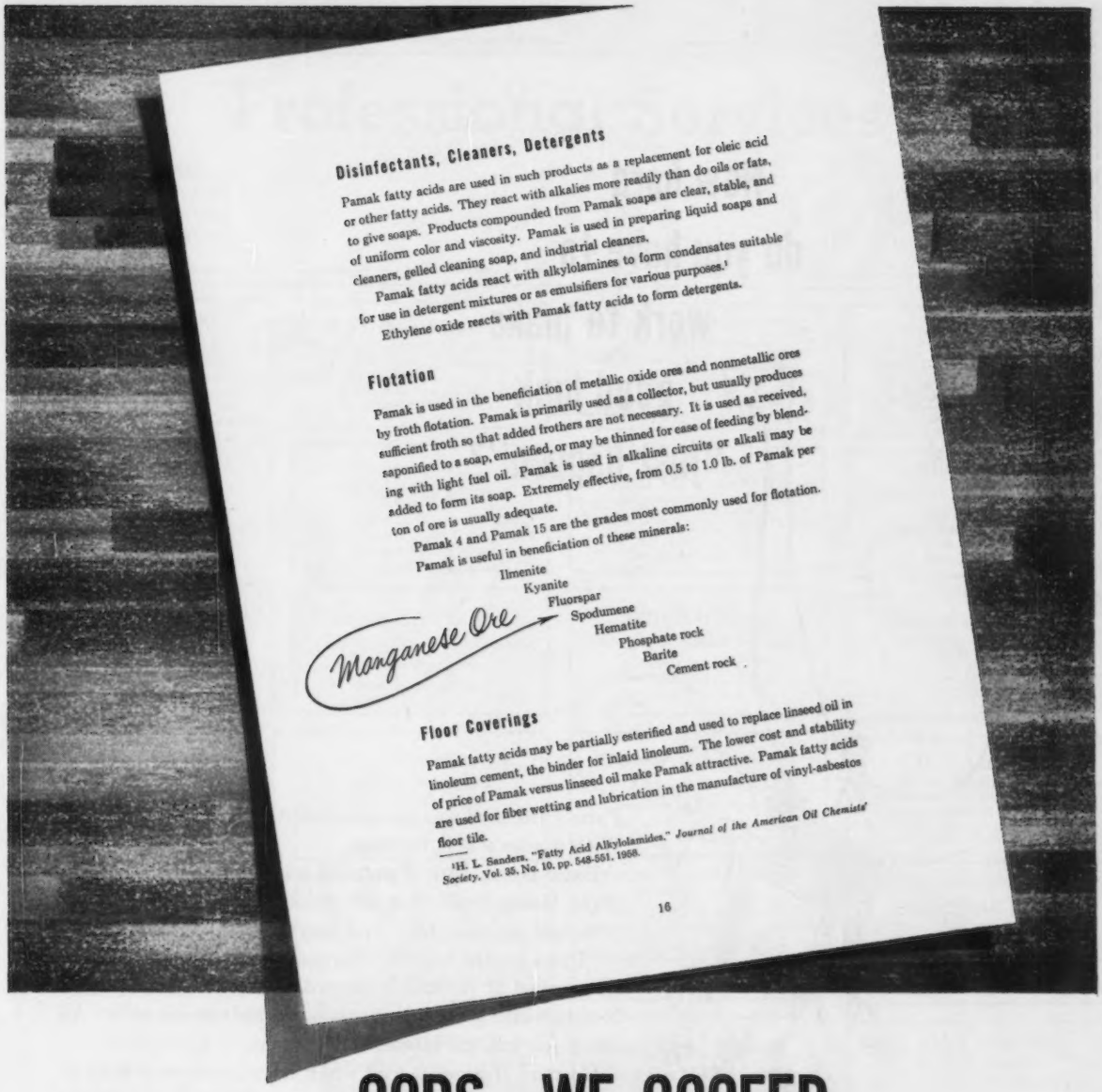
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[1]H. L. Sanders, "Fatty Acid Alkylolamides." Journal of the American Oil Chemists' Society, Vol. 35, No. 10, pp. 548-551, 1958.
16

OOPS—WE GOOFED

PAMAK® IS IDEAL FOR MANGANESE ORE, TOO

We can't even blame it on a copyreader, but when we printed our new booklet on Pamak, Hercules fatty acids from tall oil, we unintentionally omitted manganese ore from the list of materials where Pamak is exceptionally useful as a flotation agent. But we have *not* omitted our thorough research and technical service, and the high quality that consistently marks our product. If you already have your copy of this booklet, we hope you'll remember that manganese belongs. If you haven't received a copy, you'll certainly want one for your files. A postcard to Hercules will bring you your copy.

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PT60-1

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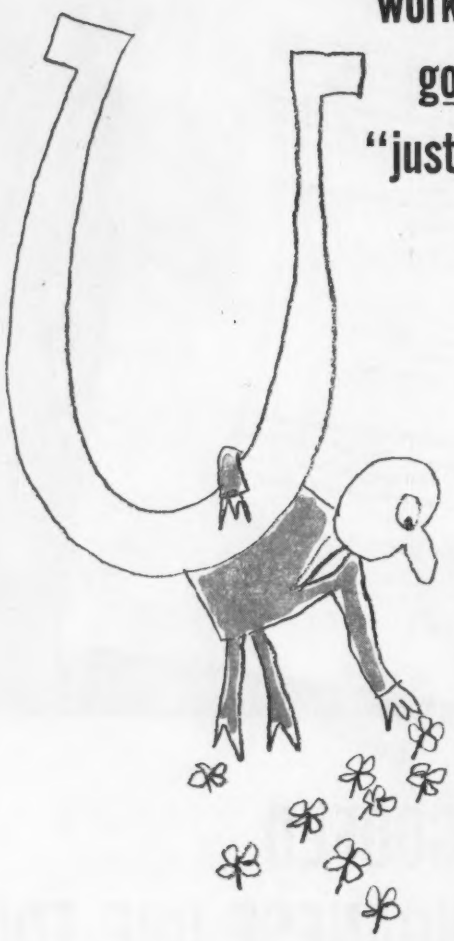

Parm Pritchard was just promoted. New production boss. With it goes a fine, fat raise.

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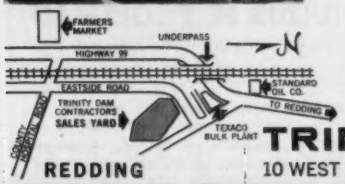

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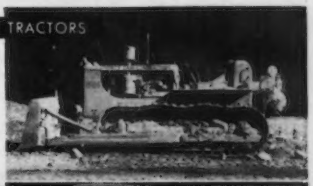

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1—7'6" x 62' rotary kiln, ½"
2—7' x 60' Bonner dryers, ⅞"
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1—Kennedy 7' x 9' ball mill 150 HP
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CRUSHER, ROLL: Double Roll 14" face, 52" dia.
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48 x 60 Allis C. see Frame Jaw Crusher
20", 34" & 42" Gyratory Primary Breakers
2—5x8 KVS Air Swept Ball Tube Mills
5—Jaw Crushers, 14"x28", 15"x24", 30"x36", 48"x72"
Hardinge Mills, 3'x8", 5'x24", 6'x48", 10'x48"
Rod Mills, 6'x12', 7'x15' & 4'x11'
Ball Mills, No. 56, 7'x18', 7'x35', 6'x4' & 6'x9'
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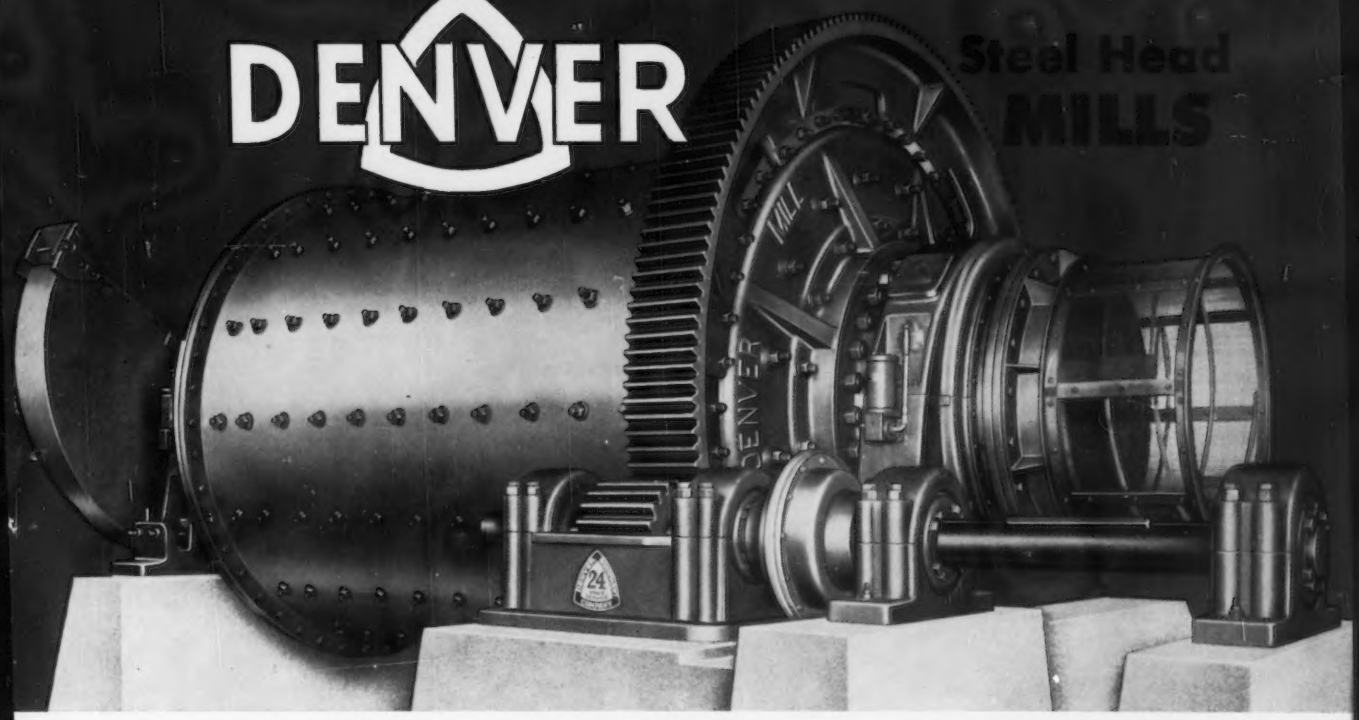

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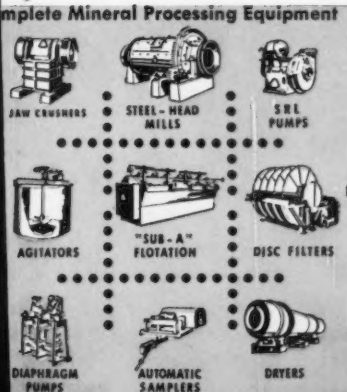

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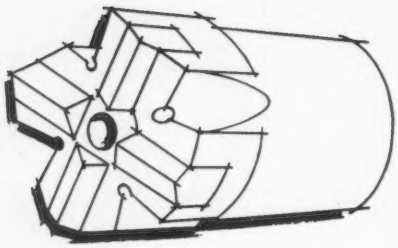

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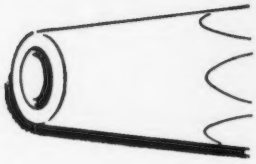

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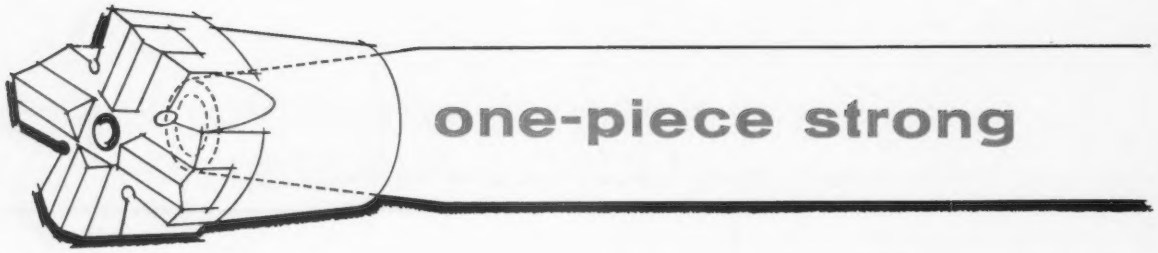

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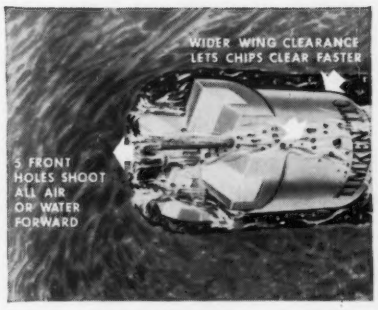

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